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Procedures for Emission Inventory Preparation
Volume I: Emission Inventory Fundamentals

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Procedures for Emission Inventory Preparation

Volume I: Emission Inventory Fundamentals

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16. ABSTRACT

Procedures are described for compiling the complete comprehensive emission inventory of the criteria pollutants and pollutant sources. These procedures described are for use in the air quality management programs of state and local air pollution control agencies.

Basic emission inventory elements--planning, data collection, emission estimates, inventory file formatting, reporting and maintenance--are described. Prescribed methods are presented; optional methods are provided. The procedures are presented in five (5) volumes:

Volume I,	Emission Inventory Fundamentals
Volume II,	Point Sources
Volume III,	Area Sources
Volume IV,	Mobile Sources
Volume V,	Bibliography

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NOTICE

The Procedures for Emission Inventory Preparation consists of these five volumes.

- Volume I - Emission Inventory Fundamentals
- Volume II - Point Sources
- Volume III - Area Sources
- Volume IV - Mobile Sources
- Volume V - Bibliography

They are intended to present emission inventory procedures and techniques applicable in State and local air programs, and for contractors and other selected users. The object is to provide the best available and "state of the art" information. For some areas, however, the available source information and data either may allow more precise procedures and more accurate estimation of emissions or may not be amenable to the use of these procedures. Therefore, the user is asked to share his knowledge and experience by providing comments, successfully applied alternative methods or other emission inventory information useful to other users of these volumes. Please forward comments to the U.S. Environmental Protection Agency, Air Management Technology Branch, (MD-14), Research Triangle Park, NC 27711. Such responses will provide guidance for revisions and supplements to these volumes.

Other U.S. EPA emission inventory procedures publications:

Procedures for the Preparation of Emission Inventories for Volatile Organic Compounds, Volume I, Second Edition, EPA-450/2-77-028, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1980.

Procedures for the Preparation of Emission Inventories of Volatile Organic Compounds, Volume II: Emission Inventory Requirements for Photochemical Air Quality Simulation Models, EPA-450/4-79-018, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1979.

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Procedures for Emission Inventory Preparation

Volume I: Emission Inventory Fundamentals

by

Monitoring and Data Analysis Division
Office of Air Quality Planning and Standards

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air, Noise and Radiation
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

September 1981

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1.0 INTRODUCTION

This volume is the first of a five volume series designed to assist personnel of air pollution control agencies in preparing and maintaining emission inventories. The next three volumes address specific areas of the inventory process, namely the preparation of inventories of point,[1] area,[2] and mobile[3] sources, respectively; the fifth volume[4] is a bibliography of pertinent publications relating to inventorying activities. Emphasis in this series is placed on a systematic approach to identifying emission data requirements and sources; collecting and processing the required information; and presenting the data in a format consistent with the intended application of the inventory. Although specific procedures for preparing the emission inventory are provided whenever possible, available options and the reasons for them are identified and discussed.

Specifically, this volume is presented as a reference guide for managers and planners of state and local air quality control programs. In conjunction with the other volumes, it serves as a resource for management's use in:

1. Planning an emission inventory,
2. Establishing an agency organization to carry on the emission inventory programs, and
3. Establishing documented procedures and quality assurance activities for emission inventory programs.

All volumes of this manual will be updated periodically to reflect current practices in inventory preparation and management.

1.1 BACKGROUND

An emission inventory is, ideally, a comprehensive, accurate and current accounting of air pollutant emissions and associated data from sources within the inventory area over a specific time interval. In addition to emission data, the information contained in the inventory data system will include source, dispersion modeling, pollution control and compliance information which can be used by the agency to determine the present and projected effect of emissions on ambient air quality.

Emission inventories have been used for many years by state and local agencies to quantify pollutant emissions within their jurisdictions. Together with ambient monitoring data, inventory emission estimates have been used as a direct indicator of annual changes in air quality. The inventory is also routinely used in the conduct of many air quality programs. For example, compliance inspections typically begin with a review of inventory-provided source data and the siting of ambient monitoring stations is often dependent upon emission information maintained in the inventory.

Many state agencies initially developed emission inventories to assist them in the development of State Implementation Plans (SIPs). These plans were required by Section 110 of the Clean Air Act and set forth the state's strategy for attaining and maintaining national ambient air quality standards (NAAQS). The use of an inventory became mandatory for certain areas with adoption of the Clean Air Act amendments in 1977. The nonattainment plan provisions (Section 172) of the amendments require the use of an inventory to document emissions in nonattainment areas.

To meet the reporting requirements of the nonattainment plan provisions, states are required to provide an emission inventory of point and area sources for the pollutant of nonattainment. Currently the EPA is requesting that states submit the emission inventory of the nonattainment areas 1 year after the date their revised SIP was submitted to the EPA Regional Office and resubmit annually for as long as the area retains its nonattainment designation. The EPA has not formally proclaimed a specific reporting format, however, the data submitted should be readily converted to the National Emissions Data System (NEDS) format.[5]

In addition, under the published provisions of Title 40 of the Code of Federal Regulations Part 51 (40 CFR 51), Subpart 51.321, state agencies are required to report annually point source emission data for certain sources to the appropriate regional office of the EPA. Point sources subject to the annual emission reporting requirements are:

> any facility that actually emits a total of 90.7 metric tons (100 tons) per year or more of particulate matter, sulfur oxides, hydrocarbons, or nitrogen oxides;
>
> any facility that actually emits a total of 907 metric tons (1000 tons) per year or more of carbon monoxide; and
>
> any facility that actually emits a total of 4.5 metric tons (5 tons) per year or more of lead or lead compounds measured as elemental lead.

In addition, reporting of annual emissions from individual emission points within a facility is required for those points for which:

> actual emissions of particulate matter, sulfur oxides, hydrocarbons and nitrogen oxides equal or exceed 22.7 metric tons (25 tons) per year;
>
> Actual emissions of carbon monoxide equal or exceed 227 metric tons (250 tons) per year; and,
>
> Actual emissions of lead, or lead compounds measured as elemental lead, equal or exceed 4.5 metric tons (5 tons) per year.

The provisions of 40 CFR 51 require that particulate matter, sulfur oxides, carbon monoxide, nitrogen oxides, and hydrocarbon emission data be submitted in the format of the NEDS point source coding forms. Emission data for lead or lead compounds measured as elemental lead must be submitted in the format of the Hazardous and Trace Emissions System[5] (HATREMS) point source coding forms.*

State agencies are required to submit emissions data in the annual report for any point source for which one or more of the following conditions occurs:

A source achieves compliance at any time within the reporting period with any regulation of an applicable plan,

A new or modified source receives approval to construct during the reporting period or begins operating during the reporting period,

A source ceases operations during the reporting period, and

A source's emissions have changed more than 5 percent from the most recently submitted emissions data.

Concerning the last requirement, if it is determined that emissions from any point source have not changed more than 5 percent from the most recently submitted emission data, the state shall only update the year of record of the previously reported emission data.

While the development and maintenance of comprehensive emission inventories are specifically mandated by the Clean Air Act for nonattainment areas, it is apparent that numerous other sections of the Act establish requirements which will also compel regulatory control agencies to compile source/emission data in some form. Specifically, source/emission inventory information will be necessary to:

Monitor sources for emissions (with exemptions under control of pollution from federal facilities (Section 118), enforcement orders under federal enforcement (Section 113(d)) suspension orders under implementation plans (Section 110(f) or (g)), or orders under primary nonferrous smelter orders (Section 119)) which may be responsible for the failure of the state implementation plan to accomplish the objectives of achieving the primary and secondary NAAQS (Section 110(a)(3)(c)).

Determine the extent to which State Implementation Plans for attainment of the NAAQS for SO_2 and particulate are dependent upon gas, oil and/or low sulfur coal supplies as required by the Assurance of Adequacy of State Plans (Section 124).

---

*There are no requirements in 40 CFR 51 for the reporting of area source emissions.

Provide data for air quality modeling as described in Standardized Air Quality Modeling (Section 320(d)) necessary to carry out the prevention of significant deterioration (PSD) required by Part C-- Prevention of Significant Deterioration of Air Quality (Section 160-169).

Inventory "Major Sources" defined in Definitions (Section 169) along with start of construction and start of operation dates to determine their contribution to baseline concentrations defined in Definitions (Section 169), or increments and ceilings as defined in Increments and Ceilings (Section 163).

Identify "Major Sources" described in Increments and Ceilings (Section 163(3)) when emissions may be exempted (temporarily or otherwise) from deterioration compliance with the maximum allowable increases in ambient concentrations of an air pollutant.

Monitor increases and decreases of individual source emissions as mentioned in Nonattainment Areas (Section 129) during the interim period until new SIPs are approved, and

Exchange data among states as may be required under Interstate Pollution Abatement (Section 126).

EPA requires that emission data be reported to them in NEDS format. NEDS specified data and NEDS format must therefore be considered at a minimum by a local agency interested in designing and implementing its own system. NEDS is a component of the federal air information system, AEROS (Aerometric and Emissions Reporting System).[5] AEROS was established by the EPA to serve as a management information system for its air pollution programs.

NEDS was the first federally-sponsored air pollutant emission inventory system, and has served as a model for many subsequent local inventory systems. NEDS is a computerized data handling system which compiles, stores, and reports on information relating to sources of any of the following five criteria pollutants: particulates, SO_x, NO_x, CO and hydrocarbons. A summary table taken from the NEDS 1977 National Emission Report[6] shows the annual United States emissions of pollutants by source category (Table 1-1). In NEDS, a major distinction is made between two types of sources: point sources and area sources. Point sources are stationary sources large enough to be identified and individually maintained in the inventory. Area sources are those stationary and mobile sources which individually do not qualify as a point source and are too small and numerous to be maintained separately in the inventory. In the NEDS, area sources are considered collectively on a county basis. Area sources include small stationary sources such as gasoline service stations, domestic and commercial heating, and all mobile sources. However, because of their distinct characteristics, mobile sources are treated separately in this series as a separate component of the emission inventory.

TABLE 1-1. NATIONAL EMISSIONS, 1977

UNITED STATES

Emission categories	Particulates	Sulfur oxides	Nitrogen oxides	Hydrocarbons	Carbon monoxide
	Pollutant, tons per year				
GRAND TOTAL	**53,424,350**	**31,477,757**	**21,736,603**	**27,737,227**	**113,715,311**
-AREA	**45,731,590**	**2,441,270**	**10,679,474**	**22,144,188**	**105,108,057**
-POINT	**7,692,760**	**29,036,487**	**11,057,129**	**5,593,039**	**8,607,254**
FUEL COMBUSTION-AREA	610,953	1,558,650	1,033,618	76,750	606,975
-POINT	3,293,792	23,370,295	9,989,438	288,969	682,155
External Combustion-area	610,953	1,558,650	1,033,618	76,750	606,975
-point	3,277,392	23,308,116	9,242,598	192,645	596,817
Residential Fuel-area	119,676	321,898	385,689	52,953	522,439
Anthracite Coal	5,069	13,497	1,494	1,238	45,708
Bituminous Coal	6,717	30,152	922	6,833	30,120
Distillate Oil	22,980	275,971	166,358	9,193	46,177
Residual Oil	0	0	0	0	0
Natural Gas	26,879	1,307	214,674	21,608	53,817
Wood	58,031	971	2,241	14,081	346,617
Electric Generation-point	2,245,438	19,797,109	7,283,960	95,173	318,585
Anthracite Coal	58,218	17,963	12,987	7	745
Bituminous Coal	1,955,765	17,060,959	4,989,850	68,009	217,944
Lignite	58,590	436,062	226,477	5,293	16,533
Residual Oil	135,762	2,097,653	1,021,903	13,786	55,863
Distillate Oil	8,711	121,416	110,083	3,607	7,419
Natural Gas	16,457	3,582	872,197	1,738	16,322
Process Gas	268	1,441	29,256	27	608
Other	11,667	58,013	21,207	2,706	3,151
Industrial Fuel-area	418,866	779,203	334,511	11,133	40,151
-point	963,233	3,254,725	1,846,437	90,832	253,695
Anthracite Coal-area	64	153	58	0	2
-point	1,326	5,364	1,105	29	467
Bituminous Coal-area	382,468	440,430	84,275	5,533	11,157
-point	485,888	1,346,751	392,828	11,466	28,899
Lignite-point	27,079	60,213	15,768	588	1,632
Residual Oil-area	24,413	266,842	80,316	1,264	6,626
-point	161,840	1,199,675	353,479	10,639	60,399
Distillate Oil-area	4,124	71,095	46,796	1,998	10,502
-point	23,605	181,575	74,120	3,339	12,694
Natural Gas-area	6,706	311	122,117	1,926	11,430
-point	25,729	48,521	744,153	12,490	57,145
Process Gas-area	19	77	86	1	3
-point	3,680	355,118	75,778	956	2,005
Coke-area	76	190	49	1	21
-point	358	2,419	912	290	18,066
Wood-area	996	105	814	410	410
-point	193,650	27,703	177,626	45,813	60,899
Liquid Petroleum Gas-point	83	601	690	12	114
Bagasse-point	28,984	144	6,426	4,787	4,668
Other-point	11,011	26,641	3,552	423	6,707
Commercial-Institutional Fuel-area	72,411	457,549	313,418	12,664	44,385
-point	68,721	256,282	112,201	6,640	24,537
Anthracite Coal-area	8,623	19,703	7,378	0	678
-point	7,260	3,312	1,536	30	1,216
Bituminous Coal-area	12,769	12,750	1,358	308	1,042
-point	44,272	86,435	18,231	1,283	3,666
Lignite-point	3,695	2,627	621	121	412
Residual Oil-area	36,214	357,264	128,813	1,983	10,575
-point	10,221	134,754	37,840	2,697	7,007
Distillate Oil-area	3,963	67,356	45,570	1,903	10,269
-point	1,103	26,150	8,333	709	3,806
Natural Gas-area	10,792	475	130,258	8,423	21,774
-point	1,346	197	40,457	1,007	5,608
Wood-area	50	1	41	47	47
-point	664	858	3,267	759	2,672
Liquid Petroleum Gas-point	21	75	100	3	17
Other-point	139	1,874	1,816	31	133
Internal Combustion-point	16,400	62,179	746,840	96,324	85,338
Electric Generation	13,603	55,595	313,305	53,814	34,793
Distillate Oil	6,627	34,972	85,179	3,157	8,391
Natural Gas	2,365	2,007	181,073	47,322	18,439
Diesel Fuel	2,647	15,986	43,880	3,070	7,744
Other	1,964	2,630	3,173	265	219
Industrial Fuel	1,917	5,859	430,967	39,933	47,648
Distillate Oil	173	787	2,474	248	355
Natural Gas	724	3,944	404,940	33,403	32,728
Gasoline	366	13	232	687	8,967
Diesel Fuel	591	736	11,857	2,429	2,101
Other	63	379	11,464	3,166	3,497
Commercial-Institutional	9	5	65	3	6
Engine-Testing	871	720	2,503	2,574	2,891
INDUSTRIAL PROCESS-POINT	4,271,750	5,636,837	1,020,549	5,191,860	7,270,791
Chemical Manufacturing	249,449	865,179	186,741	3,147,411	2,258,676
Food/Agriculture	685,412	3,320	3,249	53,791	2,406
Primary Metal	781,938	2,807,732	64,510	139,272	2,027,491
Secondary Metals	129,531	70,255	15,424	18,707	582,246
Mineral Products	1,846,725	701,356	232,596	20,419	68,816
Petroleum Industry	144,263	978,279	442,212	627,451	1,549,376
Wood Products	269,791	158,696	47,587	40,646	731,268
Organic Solvent Evaporation	16,646	240	4,662	1,607,433	2,402
Petroleum Storage/Transport	2,761	523	280	1,176,496	192
Metal Fabrication	5,852	239	3,685	71,569	39
Textile Manufacturing	1,404	848	312	38,307	27
Other/Not Classified	137,978	50,170	21,291	250,358	47,852
SOLID WASTE DISPOSAL-AREA	366,430	21,805	90,711	786,540	2,200,612
-POINT	127,218	29,355	47,142	112,219	654,308
Government-point	79,128	13,746	18,184	44,984	216,787
Municipal Incineration	50,218	9,721	8,789	10,847	121,432
Open Burning	17,899	1,093	6,607	33,403	94,358
Other Incineration	11,011	2,932	2,788	734	997
Residential-area	326,624	13,867	75,889	740,192	2,158,837
On Site Incineration	135,528	1,865	4,072	381,210	1,143,541
Open Burning	191,096	12,002	71,817	358,982	1,015,296
Commercial-Institutional-area	24,375	4,989	9,059	27,527	71,656
point	10,610	4,974	16,464	9,262	29,880
On Site Incineration-area	14,593	4,562	5,440	9,313	21,288
-point	10,541	4,970	16,440	9,164	29,519
Open Burning-area	9,782	427	3,619	18,214	50,368
point	69	4	24	98	361
Industrial-area	15,431	2,949	5,763	18,821	50,119
point	37,480	10,635	12,494	57,964	407,641
On Site Incineration-area	8,274	2,589	3,041	5,333	12,382
point	31,263	10,359	10,476	40,849	360,843
Open Burning-area	7,157	360	2,722	13,488	37,737
-point	6,217	276	2,018	17,115	46,798
Rail Car Burning-point	2	0	0	2	4
TRANSPORTATION-AREA	6,094,037	856,434	9,415,763	12,772,620	97,166,875
Land Vehicles	5,992,091	619,223	9,124,573	12,077,156	94,883,123
Gasoline	5,497,856	233,722	6,018,780	11,524,292	92,649,711
Light Duty Vehicles	4,387,762	162,273	4,255,355	7,959,818	61,139,608
Light Duty Trucks	839,085	42,992	949,581	1,735,773	12,476,026
Heavy Duty Vehicles	255,962	20,566	638,658	1,382,246	13,577,297
Off Highway	15,047	7,891	175,186	446,455	5,456,780
Diesel Fuel	494,235	385,501	3,105,793	552,864	2,233,412
Heavy Duty Vehicles	358,596	192,954	1,412,164	257,499	1,703,169
Off Highway	84,072	75,356	933,166	102,177	263,003
Rail	51,567	117,191	760,463	193,188	267,240
Aircraft	66,480	15,797	131,362	233,602	876,151
Military	62,059	5,820	37,308	110,409	198,828
Civil	256	84	427	9,424	435,315
Commercial	4,165	9,893	93,627	113,769	242,008
Vessels	35,466	221,414	159,828	461,862	1,407,601
Bituminous Coal	9,416	4,472	177	1,177	5,295
Diesel Fuel	12,662	15,844	118,128	30,998	41,333
Residual Oil	13,388	198,321	28,984	2,007	968
Gasoline	0	2,777	12,539	427,690	1,360,005
MISCELLANEOUS-AREA	38,660,170	4,381	139,382	8,508,278	5,053,595
Forest Wildfires	366,704	3,066	86,277	517,643	3,019,615
Structural Fires	57,793	65	6,728	43,155	234,817
Forest Managed Burning	147,307	1,250	34,659	207,971	1,213,178
Agricultural Burning	99,621	0	11,718	117,206	585,985
Frost Control	0	0	0	0	0
Solvent Evaporation Loss	0	0	0	6,485,596	0
Gasoline Sta Evaporation Loss	0	0	0	1,136,707	0
Unpaved Roads	37,979,453	0	0	0	0
Unpaved Airstrips	9,292	0	0	0	0
Construction	0	0	0	0	0
Land Tilling	0	0	0	0	0
Miscellanous Wind Erosion	0	0	0	0	0
Other/Not Classified	0	0	0	0	0

Source: Reference 6.

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The EPA Regional Offices are responsible for receiving, processing and editing NEDS data. The Regional Offices and the National Air Data Branch of OAQPS also provide automatic data processing assistance to state and local agencies in areas such as data processing and auditing and personnel training. A majority of the states are currently compiling their inventory data on the EPA-developed Emission Inventory System/Point Source Subsystem (EIS/PS)[7] and the Emission Inventory System/Area Source Subsystem (EIS/AS)[8] of the Comprehensive Data Handling System (CDHS). Through EPA, programs are available that convert CDHS data to the NEDS point source and area source formats and allows data to be added, changed, and deleted. The CDHS subsystem programs satisfy state requirements for reporting source emission data annually to EPA.

The Aerometric Information Reporting System (AIRS) has been proposed by EPA to replace the existing AEROS and CDHS systems. This system will integrate all data pertaining to Air Quality Siting, Raw Air Quality Data, Air Quality Summary Information, Point and Area Source Engineering and Enforcement Information, and Air Quality Assurance Information. AIRS will provide state agencies with direct access to the data base for editing and validation of input data and for report retrievals. The system will also provide increasing report capabilities for all users (such as graphics and statistical analysis packages) and will incorporate a more flexible system design capable of meeting changing aerometric data requirements as well as allowing states to define and store unique sets of data in addition to those data required to be reported to EPA. A target date of 1985 is set for operation of this new system.

1.2 EMISSION INVENTORY OVERVIEW

Because an emission inventory is the repository for pollutant related data, it is the key element in all agency programs aimed at improving and maintaining air quality within the Agency's jurisdiction. The impact of control strategies on emissions can be directly assessed and the resulting impact on ambient air quality determined by dispersion modeling. Although the major purpose of the inventory is to quantify all emissions within the total jurisdiction, the Agency may at certain times focus its activities on specific pollutants; e.g., nonattainment pollutants, or special geographical areas, such as areas of high emission density. Once the key sources and source categories are identified by management, the source and emission data are obtained by means of survey questionnaires, source inspections, permit application reviews, statistical data source analysis or other means. Actual quantification of emissions is accomplished through the use of source tests, material balances, or the application of emission factors. Once this initial quantification effort is completed, the inventory must be regularly maintained by updating source activity information and by adding or deleting sources as such events occur. Emission inventory maintenance efforts must be planned to ensure that the inventory data are current and accurate and sufficient for the needs of the agency.

The emission inventory process can be divided into the following components:[9]

Planning--Mangement must identify emission inventory requirements associated with agency programs and integrate the inventory activities into their overall program by assigning an inventory coordinator and establishing a work group structure. The various planning aspects discussed in the following chapter should all be considered prior to initiation of the actual data gathering phase of the inventory effort. Documented written procedures must be developed for all inventory activities including source identification, data collection and analysis, data reduction and insertion into the source file record format, presentation of the data, and quality assurance. All procedures should be documented for approval by management and the technical staff prior to the initiation of data gathering activities.

Data Collection--A major distinction involves which sources should be considered point sources in the inventory and which should be considered area sources. Fundamentally different data collection procedures are used for these two source types. Individual plant contacts are used to collect point source data, whereas collective information is generally used to estimate area source activity and emissions for area source categories. Much more detailed data are collected and maintained on point sources.

Data Analysis--All source data collected must be checked for completeness and accuracy. Calculation of emissions, using source test data, material balance and emission factors, and examination of process information should be undertaken to validate the data or to identify potential errors. Recontacting of specific point sources and sources of area source activity data may be necessary to correct deficiencies.

Data Reduction and Formatting--The validated data and source infomration must be reduced to a predesigned uniform source format and entered into the data file. A computerized data file is recommended to facilitate calculations and error checks using documented quality assurance procedures.

Data Reporting--Various report formats and presentation styles need to be investigated and formats adopted consistent with the data handling system and the intended applications of the inventory data.

An emission inventory data system is an information recordkeeping and processing system designed around emission data. The system may be either manual or automatic, but must be designed to handle all source information deemed by the agency to be relevant to their programs. Automated system designs must incorporate retrieval capabilities that allow the agency to segregate all sources with a common operating or emission characteristics (pollutant emission rate, process type, location, etc.). The system must be sufficiently flexible to allow the recording of point, area, mobile, and fugitive dust source data.

The following information is typically required for point source and area sources. (Data requirements for State Implementation Plans are specified in 40 CFR 51, Appendix E and F for point and area sources, respectively.)

Point Source Data

General source information--Name, address, type of source, year of record, comments, etc.
Emission-related data--Operating or production rate, estimated emissions, EPA calculated emissions, control device type and efficiency, etc.
Modeling parameters--UTM coordinates of source, stack height, and diameter, exhaust gas temperature, and flow rate.
Compliance-related information--Allowable emissions, applicable control regulations, compliance status, and schedules, etc.

Area Source Data

General source information--Name and location of area (county) source, population, year of record.
Activity levels--Countywide activity level of each area source category (e.g., tons of coal burned in all residential space heating equipment in a county).
Emission data--Emission estimates for the entire county, for each pollutant and for each area source category.

Whatever the intended use of the immediate inventory activity, it must be conducted using standard documented methods. It is also necessary that standard procedures for maintaining and updating the comprehensive inventory be developed to ensure that the inventory remains accurate and complete.

1.3 PURPOSE AND ORGANIZATION OF THE PROCEDURES FOR EMISSION INVENTORY PREPARATION SERIES

The emission inventory preparation series consists of five separate volumes and serves as a comprehensive technical reference manual for establishing an emission inventory of point, area and mobile sources. The series, prepared for use by state and local air quality control agencies, presents the most recent techniques for obtaining, quantifying and handling emission related data. The series consists of the following volumes:

Volume I--Emission Inventory Fundamentals

Volume II--Point Sources

Volume III--Area Sources

Volume IV--Mobile Sources

Volume V--Bibliography

Each volume defines the rationale and procedures necessary to prepare or upgrade an emission inventory and includes examples to assist the user in understanding specific methods and procedures. An important feature of the multivolume series is the fact that it can be updated periodically to include new information on pollutants, source categories, emission factors and data handling as it becomes available.

1.3.1 VOLUME I: EMISSION INVENTORY FUNDAMENTALS

Emphasis is placed in this volume on the need for careful planning to ensure that the emission inventory is accurate, complete and current and is consistent with agency requirements, including manpower and schedules. The many applications and users of the inventory are identified and data requirements for various levels of a comprehensive inventory are noted. The process of collecting and quantifying emission data is next addressed including a section on data analysis and validation, quality assurance and inventory maintenance. General techniques for displaying inventory information are presented with several illustrative examples shown. Finally, this volume presents a manpower resource model in which the time required to complete each individual task of inventory preparation is estimated. This model will assist managers in estimating inventory manpower requirements. An appendix to Volume I includes a glossary of terms employed by air pollution control agencies in conducting emission inventories (and other regulatory functions). This list of terms provides a uniform set of definitions which can be consistently and logically applied during the inventory process.

1.3.2 VOLUME II: POINT SOURCES

Volume II provides methods and techniques for identifying and quantifying the emissions from point sources of pollution. Techniques for identifying and contacting all major emitters, specific data procurement techniques, methods of data analysis and validation are presented, including procedures for the calculation of emissions using emission factors, process material balances and engineering appraisals. Reporting techniques specific to point sources are identified followed by a general discussion of problems encountered with specific source groups, such as combustion sources, the chemical process industry and the metallurgical industry. Example questionnaires of both a general and industry-specific nature are provided in the appendicies.

1.3.3 VOLUME III: AREA SOURCES

Volume III outlines the methods of collecting and handling emission data from sources too small and/or too numerous to be surveyed individually, collectively known as area sources. Procedures are discussed which will assist the user in identifying area source categories and important reference materials which can be used to determine the activity levels associated with these source categories. Emission factors, emission calculations, pollutant allocation and projection techniques, and methods of data presentation are identified and reviewed to assist the agency in the preparation and maintenance of the area source emission inventory. Specific emphasis is placed on the major area source categories: combustion sources, solid waste disposal, fugitive dust sources and solvent sources.

1.3.4 VOLUME IV: MOBILE SOURCES

This volume concentrates on both traditional and nontraditional mobile sources of pollution. Both traditional sources, such as on-highway vehicles and airports, and the less common sources, such as off-highway vehicles, aircraft, railroads, and vessels, are discussed in detail. For each category the data requirements, sources of data, procurement techniques and calculation methods are presented. State-of-the-art computer dispersion modeling techniques for this group of sources are discussed.

1.3.5 VOLUME V: BIBLIOGRAPHY

This volume presents an extensive listing of reference material currently available in the literature which will assist the user in the development of the emission inventory. A concise abstract outlining the pertinent emission inventory information is provided for each reference cited.

References for Chapter 1.0

1. Procedures for Emission Inventory Preparation - Volume II: Point Sources, EPA-450/4-81-026b, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1981.

2. Procedures for Emission Inventory Preparation - Volume III: Area Sources, EPA-450/4-81-026C, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1981.

3. Procedures for Emission Inventory Preparation - Volume IV: Mobile Sources, EPA-450/4-81-026d, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1981.

4. Procedures for Emission Inventory Preparation - Volume V: Bibliography, EPA-450/4-81-026e, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1981.

5. AEROS Manual Series, Volume II, AEROS User's Manual, EPA-450/2-76-029, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1980 (Update No. 3).

6. 1977 National Emissions Report, EPA-450/4-80-005, U.S. Environmental Protection Agency, Research Triangle Park, NC, March 1980.

7. The Emission Inventory System/Point Source User's Guide, EPA-450/4-80-010, U.S. Environmental Protection Agency, Research Triangle Park, NC, May 1980.

8. The Emission Inventory System/Area Source User's Guide, EPA-450/4-80-009, U.S. Environmental Protection Agency, Research Triangle Park, NC, May 1980.

9. Procedures for the Preparation of Emission Inventories for Volatile Organic Compounds, Volume I, Second Edition, EPA-450/2-77-028, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1980.

2.0 MANAGEMENT AND PLANNING OF THE EMISSION INVENTORY PROGRAM

The air pollution emission inventory provides the technical foundation for all agency programs designed to improve or maintain ambient air quality within its jurisdiction. An accurate, comprehensive, and current record of all sources of air pollutants and their emissions is essential for the assessment of existing air quality and the development of future control strategies.[1,2]

The maintenance of the emission inventory is a dynamic process, reflecting technical improvements in inventorying methods and procedures and the changing patterns of emissions within a region. Periodic updates, in addition to providing a current data base, can further improve the accuracy and usefulness of the inventory as:

(1) additional information is added to improve the spatial and temporal resolution of the inventory;

(2) new technology is used to identify additional sources, develop and improve emission factors, and provide better definition of emissions with regard to speciation (e.g., compound identification of VOC emissions or the fine particulate fraction of total particulate emissions) and new pollutant identification (e.g., hazardous pollutants);

(3) data management systems are upgraded to improve data handling, analysis, validation and reporting; and

(4) errors are eliminated and confidence in the reliability of the inventory improved through documentation, quality assurance, and ultimately the demonstrated utility of the inventory for assessing control strategies and air quality.

Agency management is charged with the responsibility of developing, maintaining, and upgrading the inventory. To effectively carry out this mandate, management must:

(1) Understand and appreciate the uses and significance of the inventory as applied to existing and future agency programs (as a corollary, management must also understand the limitations of the existing inventory and the benefits to be realized from activities aimed at reducing these limitations);

(2) Understand the managerial and technical requirements involved in emission inventorying activities which require:

    (a) Interfacing of personnel and support facilities within the agency to provide the full range of necessary skills;

    (b) Identifying all methods and procedures used in inventorying;

(c) Training of personnel in the use of the above techniques;

(d) Utilizing, to the extent possible, technical support within and outside the agency to upgrade the inventory process; e.g., by updating emission factors, utilizing available computer programs, or identifying useful data bases available within the agency or from other Federal, state and local agencies;

(e) Documenting inventorying activities and using quality assurance procedures to eliminate errors from the data base and assess the quality of the inventory; and

(3) Utilize (1) and (2) above to effectively plan and conduct inventory activities within a schedule consistent with the immediate and the overall needs of the agency.

The uses and applications of the emission inventory are described in detail in Chapter 3. Specific limitations of the inventory and corrective procedures are discussed in detail in Volumes II,[3] III,[4] and IV[5] which discuss inventorying methods and procedures for point, area, and mobile sources, respectively. The following subsections within this Chapter will address the managerial and technical requirements of inventorying activities and the planning and scheduling of such activities by agency management.

2.1 EMISSION INVENTORY PROGRAM ORGANIZATIONAL STRUCTURE

Management must have a thorough knowledge of the organizational structure of the air quality agency and the areas of responsibility of each department or branch within the agency. This knowledge is necessary because emission inventory activities, in most agencies, are carried out by emission inventory program personnel drawn from several branches of the agency. Management must establish priorities, vis-a-vis other branch and interbranch activities, assemble an emission inventory project team, and establish and maintain a project plan, including schedule, consistent with the priorities and magnitude of the inventorying effort.

2.1.1 AGENCY ORGANIZATIONAL STRUCTURE

Typically, local and state agencies are divided into various areas of responsibility.[6] The specific organizational structure will vary from agency to agency, and may not be identical to that presented in Figure 2-1. However, the following discussion of branch functions is relevant to all agencies, regardless of their individual organizational structure.

The Engineering Branch handles source-related functions that involve process, control system, and emission analyses. The results of such activities provide primary inputs to agency actions such as the issuing of construction, operating, emissions offsets, and prevention of significant deterioration permits; new source reviews; environmental impact reviews; emission inventory operations; and any special studies such as energy analysis. While engineers in this group operate primarily in the central agency office, they make field visits as required.

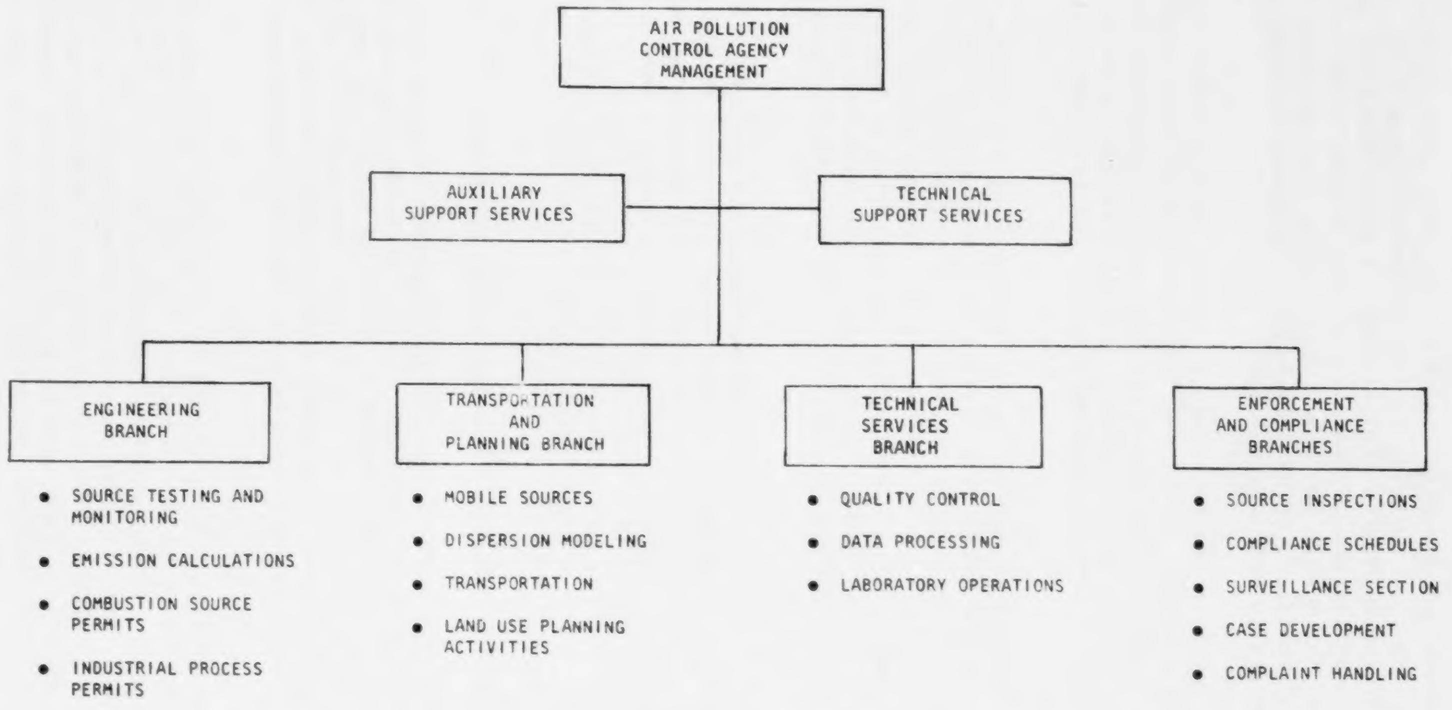
AIR POLLUTION CONTROL AGENCY MANAGEMENT
AUXILIARY SUPPORT SERVICES
TECHNICAL SUPPORT SERVICES
ENGINEERING BRANCH
• SOURCE TESTING AND MONITORING
• EMISSION CALCULATIONS
• COMBUSTION SOURCE PERMITS
• INDUSTRIAL PROCESS PERMITS
TRANSPORTATION AND PLANNING BRANCH
• MOBILE SOURCES
• DISPERSION MODELING
• TRANSPORTATION
• LAND USE PLANNING ACTIVITIES
TECHNICAL SERVICES BRANCH
• QUALITY CONTROL
• DATA PROCESSING
• LABORATORY OPERATIONS
ENFORCEMENT AND COMPLIANCE BRANCHES
• SOURCE INSPECTIONS
• COMPLIANCE SCHEDULES
• SURVEILLANCE SECTION
• CASE DEVELOPMENT
• COMPLAINT HANDLING

Figure 2-1. A typical organizational structure of an air pollution control agency.

The Transportation and Planning Branch is involved with all mobile source and planning activities. In addition to their involvement with the automobile inspection and maintenance program, this branch is responsible for the development of new regulations, implementation plan reviews, and control strategy development for mobile sources. This branch also prepares all land use density maps and similar aids used in highway maintenance planning. Overall, their function is analysis related.

The Technical Services Branch provides support through laboratory analysis and quality control operations. Laboratory activities conducted in support of ambient monitoring and stack testing, oil or hazardous waste sample analysis and quality assurance and quality control programs, such as equipment calibration and laboratory performance audits, are the responsibility of this branch.

Engineers and inspectors working in the Enforcement and Compliance Branch are responsible for source activities related to compliance, as well as for the operation of ambient monitoring stations. All compliance, NSPS, and NESHAPS inspections, as well as source testing and routine source surveillance programs, are conducted by this branch. The investigation of special problems, such as events involving chemical spills and hazardous waste sites, is carried out by the Enforcement Branch which concentrates on field activities.

Typically, there is substantial ongoing interbranch activity. Engineering and Planning Branches often rely on data obtained by the Enforcement Branch. This branch, in turn, relies on laboratory support for technical services, and all branches utilize support services such as data processing. Few agency activities are totally the jurisdiction of one branch. Due to this interbranch coordination, the formation and operation of an emission inventory task force will not require substantial, if any, changes in the typical operational mode of the agency.

2.1.2 EMISSION INVENTORY TASK FORCE ORGANIZATIONAL STRUCTURE

Most agencies, as a result of ongoing inventorying efforts, will have in place a structure consisting of personnel charged with the responsibility of maintaining the emission inventory data file and with conducting additional inventorying activities as required by the agency. The existence of an emission inventory activity and structure within an agency provides the foundation for any additional emission inventory activity deemed necessary by the agency.

All emission inventory activity should be undertaken under the direction of an emission inventory program coordinator. The coordinator, typically a member of the Engineering Branch, will be responsible for the day-to-day inventorying activities, transforming management directives and guidelines into specific tasks and actions. The coordinator will also play an active role in defining the short and long term goals of the emission inventory process consistent with the needs of the agency. Program plans relating to maintaining and upgrading the inventory and for conducting specific assignments to assist the agency in its assessment of control strategies will be prepared by the coordinator in conjunction with management. These plans, whether defining long range goals or short term objectives of specific emission inventory activities, should define manpower requirements and schedules and fully document in writing the objectives and procedures of the inventorying activity.

All personnel who will be involved in emission inventory activities such as data collection and processing should be made aware of the reason for their involvement and be able to relate their activities to those of other members of the project team and to the needs of the agency. Certain short term objectives of the inventory will also set specific data requirements. For example, an agency as part of its ongoing emission inventory may elect to include in its point source file all dry cleaning sources or all sources of lead. In such specific inventory activities the number of pollutants to be surveyed, their level of temporal and spatial resolution, and industrial and source descriptions are data established by the specific requirement for the inventory.

Management must decide the most cost-effective means of obtaining and processing the required data for the maximum number of sources. Management may choose to use a questionnaire in order to contact sources rather than actual source visits, or it may decide to survey only selected "representative" sources, and scale the data to the entire sample population. Management's selection of a collection method will also be affected by the availability of automatic data processing (ADP) capability. Large-scale inventory efforts, involving hundreds of sources, will realistically use ADP.[1,2] Manual techniques, while practical for smaller inventory efforts, cannot efficiently handle the extensive amount of data collected for a comprehensive emission inventory. Management must decide the extent of the inventory in terms of industries and sources to be surveyed, inventory methods, use of ADP, and overall manpower and resource commitments. The performance of specific work aspects of the program should be left to the coordinator. Questions such as who will log in returns, what to include in a survey questionnaire, and how and when to recontact sources for data verification should be the responsibility of the coordinator. This individual should be best able to handle the day-to-day needs of the project.

An end result of the development of the project plan will be an estimate of the manpower requirements and schedule.[7,8] To ensure that the emission inventory accomplishes all of its objectives, yet minimizes resource requirements, a manpower utilization plan must be developed. To do so, the emission inventory program is broken down into its component parts and each part is allocated a given number of "man-hours." Chapter 7 of this volume presents a manpower model for a planning effort of this nature, based, in large measure, on experience and on information presented in References 6 and 7. Personnel assignments will be the responsibility of the project coordinator, however, management must coordinate personnel assignments with the various branch chiefs and establish priorities for assignments. Management is ultimately responsible for ensuring that tasks are completed within their allocated time frame, and redirecting resources if a problem arises in an area that requires more time than initially scheduled. Management must ensure that some feedback mechanism is incorporated into its program plan. Feedback mechanisms to quickly identify problems during the preparation of the inventory and problems associated with the data base and its use can forstall the development of more serious future difficulties. The inventory coordinator must monitor the hours spent on every task each week, and report back to management, weekly or biweekly, on the progress of the program.

2.2 PLANNING

The basic elements of an emission inventory are (a) planning; (b) data collection; (c) data analysis and validation; (d) data formatting and handling, and (e) reporting. Management will be most directly involved with planning, which in itself involves all other program elements. Management must hold itself responsible to initiate, conduct, and direct the completion of a program plan and the design of a program structure for the continuous development of the inventory. The progress of the inventory effort should be monitored continually and actions instituted to redirect the agency's efforts should changes occur.

2.2.1 GENERAL PLANNING CONSIDERATIONS

Prior to initiating the actual compilation of an inventory of point source emissions, the agency's management and technical staff must carefully assess the needs and objectives of the inventory. At the end of the planning period, and prior to initiating the data collection phase, the agency will have addressed the items listed below.[8]

The end use(s) of the inventory are established.

Sources and source categories have been defined which are compatible with available source and emission information, and are of sufficient detail to facilitate control strategy projections, excluding nonreactive compounds in the case of a volatile organic compound (VOC) emission inventory.

The role of existing inventory data has been determined and any previously omitted data and sources have been identified.

The point source cutoff has been defined. Sources smaller than the cutoff limit will be treated as area sources.

The geographic area has been identified. Typically, this area will consist of the agency's entire jurisdiction.

Decisions have been made on whether to temporally adjust emissions, also to what level; seasonally or daily.

The point source data collection methods have been determined.

Procedures for identifying nonreactive emissions have been selected.

The agency has decided on how emissions will be projected, and the projection period, including end year and intermediate years, has been designated.

An inventory data handling system has been selected and coding forms developed for loading the system..

The agency's future use of dispersion models has been considered and the appropriate adjustments in inventory plans have been made.

Quality assurance procedures have been selected and a quality assurance coordinator identified for the program.

Manpower and budget allocations have been made and organization has been established by assigning authority and responsibilities.

2.2.1.1 End Uses of the Inventory

A basic consideration in planning the inventory is establishing the end uses of the completed inventory. The end uses of all inventories fall into two general categories: (1) air quality control strategy development and air quality maintenance and (2) air quality research. Possible future use of the inventory as well as immediate objectives should be considered in determining procedure and data needs.

The Clean Air Act Amendments of 1977 requires the development of emission inventories, which are far more detailed and comprehensive than previously specified and those currently available in many control agencies throughout the country.[2]

Air quality research inventories fulfill agency's requirements for studying relationships between emissions and ambient air quality. The agency, during the conduct of research programs, may collect data which is more detailed and extensive than that required by legislation. The agency can elect to include those data in the comprehensive inventory depending upon future needs and update requirements.

2.2.1.2 Sources of Emissions

An important consideration affecting emission inventory accuracy is whether the agency has included all point sources and area source categories in its emission inventory. Volumes II,[3] III,[4] and IV[5] describe procedures for identifying individual point, area and mobile source categories. Additional information concerning source identification can be found in other EPA reports such as References 8 and 9 which deal with sources of VOC emissions.

It is important that all of the emitting points that may be associated with individual sources or source categories be identified if an accurate inventory is to be prepared. For example, a petroleum refinery contains many emission points ranging from process heaters to individual seals and pumps. General process and emission information can be obtained from AP-42.[10] Other EPA publications including the Control Technique Guidelines series for specific VOC source categories,* Industrial Process profiles for environmental use such as Reference 11, Source Assessment reports such as Reference 12, and many references contained in Volume V[13] of this series provide source and emission data that will be useful to agency personnel in preparing a complete inventory of all sources.

2.2.1.3 Point/Area Source Distinctions

A major distinction typically made in inventories is between point and area sources. Point sources are those facilities/plants/activities for which individual source records are maintained in the inventory. Under ideal circumstances, all sources would be considered point sources. In practical applications, only sources that emit more than some specified cutoff level of pollutant are considered point sources. Depending on the needs of the agency, this cutoff level will vary. Area sources, in contrast, are those activities for which aggregated source and emission information are maintained for entire source categories rather than for each source therein. Sources that are not treated as point sources must be included as area sources. The cutoff level distinction is especially important in the VOC inventory because there are many more small sources of VOC than of most other pollutants.

If too high a cutoff level is chosen, many facilities will not be considered individually as point sources, and if care is not taken, emissions from these sources may not be included in the inventory at all. Techniques are available for "scaling up" the area source inventory to account for missing sources amd are presented in References 8 and in Volume III[4] of this emission inventory series. Area source procedures are invariably less accurate than point source methods.

If too low a cutoff level is chosen, the result will be a significant increase (1) in the number of plant contacts of various sorts that must be made and (2) in the quantity of data that must be compiled and maintained. While a low cutoff level may increase the accuracy of the inventory, the tradeoff is that many more resources are needed to compile and maintain the inventory.

A required upper limit on the point source cutoff level is 100 tons/year and a lower cutoff level is encouraged to account for many source categories which are identifiable, controllable, and collectively significant. For example, many VOC sources emitting less than 25 tons per year were identified in a recent study of VOC emissions from urban industrial sources.[14] Moreover, many of these sources are in categories for which no reliable area source inventory procedures currently exist. Because of this, some agencies have elected to define cutoff levels at or below 5 tons per year in order to include a large percentage of VOC and other emissions in the point source inventory.

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*Available from the Director, Emissions Standards and Engineering Division, Mail Drop 13, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711.

2.2.1.4 Geographical Area/Spatial Resolution

The geographical area to be inventoried is defined herein as that area which falls within the jurisdiction of the state agency conducting the inventory. Emission points within this area must be precisely located. Dispersion modeling studies sometimes require that point sources be determined to within 10 meters. Although existing sources contained in NEDS are only specified to 100 meters, a resolution of 10 meters is recommended whenever possible. Two grid systems have been developed for locating geographical points: (1) latitude and longitude and (2) universal transverse mercaptor (UTM). Advantages of the UTM grid system include the following.

1. Grids are continuous and are not hindered by political subdivisions.

2. UTM grids are uniform.

3. The UTM system is used worldwide.

4. The UTM system is associated with a growing body of technical information.

2.2.1.5 Temporal Resolution

Emission data for a calendar year have historically been collected by most agencies, mainly because activity levels are most readily available on an annual basis. In some cases the agency may need to adjust annual emissions rates to a seasonal, daily or hourly basis. Certain source categories operate only during certain hours of the day or during certain seasons of the year; e.g., many sand and gravel operations. Activity levels and corresponding emissions from other categories (e.g., mobile sources, surface coating, pesticide application and small boiler operations) are strongly temporal dependent. Other categories such as solvent storage are also temperature-dependent.[8] Temporal variations in emission rates, because of their influence on ambient pollutant levels, must be considered by the agency in defining the data requirements of the inventory.

2.2.1.6 Data Collection Methods

Methods for collecting data for point, area and mobile sources of emissions are presented in Volumes II, III, and IV, respectively.[3,4,5] However, the inventorying agency must decide which procedures to use in its inventory effort. Point source methods include mail surveys, plant inspections, and use of agency permit and compliance files. Area and mobile source methods are usually dependent upon correlative relationships among statistical parameters and activity levels/emissions. The agency should determine in the planning phase what methods and reference sources will be used in data collection. Early definition will allow time to obtain necessary reference and support materials and will help to better allocate work hours to the individual data collection tasks as well. Data collection methods and considerations for their use are discussed in greater depth in Chapter 5.

2.2.1.7 Special Procedures

Special procedures may be required to obtain information not normally obtained when compiling an emission inventory. This information may be temporal data or relate to pollutant characterization; e.g., fraction of inhalable particulate or organic compound identification . While most volatile organic compounds ultimately engage in photochemical reactions, some are considered nonreactive under atmospheric conditions. Therefore, controls on the emissions of these nonreactive compounds do not contribute to the attainment and maintenance of the National Ambient Air Quality Standard for ozone. These nonreactive compounds are listed below:

Methane
Ethane
1,1,1-Trichloroethane (methyl chloroform)
Methylene chloride
Trichlorofluoromethane (CFC 11)
Dichlorodifluoromethane (CFC 12)
Chlorodifluoromethane (CFC 22)
Trifluoromethane (FC 23)
Trichlorotrifluoroethane (CFC 113)
Dichlorotetrafluoroethane (CFC 114)
Chloropentafluoroethane (CFC 115)

The above compounds should be excluded from emission inventories used for ozone control strategy purposes. References 8 and 9 should be referred to for more detailed information on excluding nonreactive VOC from emission totals. Because the above list may change as additional information becomes available, the inventory agency should remain aware of EPA policy on reactivity.

Even though data are not needed in the basic inventory, the agency may find it expedient to collect this information when plant contacts and surveys are made as part of a routine update of the inventory. If an agency anticipates the need for special data, it is more efficient to collect the data at the same time the other source and emission data are collected for the basic inventory.

2.2.1.8 Emission Projections

During the planning stage of the emission inventory, it is necessary to identify the type of emission projection procedures that will be used. The two types of emission projection procedures are baseline and control strategy. The agency will need to evaluate its current emission control strategy and determine the likelihood of the promulgation of additional control measures which would affect emissions during the projection years. If it appears that there will be limited changes in the control strategy, then the agency should plan to employ the baseline projection procedure. However, if it appears that new regulations will be enacted which will affect emissions, then the agency should employ the control strategy projection procedure.

2.2.1.9 Status of Existing Inventory

A major inventory planning consideration is whether or not and to what extent information contained in an existing inventory can be utilized. The existing inventory should be examined to see if the appropriate sources have been included and that the emission data are representative of current conditions. Existing inventories serve as a starting point for developing a mailing list for questionnaire distribution and should provide extensive data and support information, such as documentation of procedures.

2.2.1.10 Data Handling

Data handling and retrieval can be done by computer or manually. Combinations of these methods are also possible. The selection of one approach over the other will depend on several factors:

Availability of a computer,

Size of the inventory data base,

Complexity of the emission calculations,

Number of calculations to be made,

Variety of tabular summaries to be generated,

Availability of clerical and data handling personnel, and

Time constraints.

Computer data handling becomes significantly more cost effective as the data base, the variety of tabular summaries, or the number of iterative tasks increases. In these cases, the computerized inventory requires less time and has the added advantage of forcing organization, consistency, and accuracy.

Some of the activities which can be performed efficiently and rapidly by computer include:

Printing mailing lists and labels;

Maintaining status reports and logs;

Calculating and summarizing emissions;

Performing error checks and other QA functions;

Storing source, emission, and other data;

Sorting and selective accessing of data; and

Generating output reports.

During the planning stages, an agency should anticipate the volume and types of data handling needed in the inventory effort, and should weigh relative advantages of manual and computerized systems. If an agency must deal with large amounts of data, a computerized inventory data handling system allows the agency to spend more time gathering, analyzing and validating the inventory data as opposed to merely manipulating it. The computerized approach is superior for large areas having a diversity of sources comprising a complex inventory.

If the agency anticipates use of a photochemical dispersion model at some future date, it is imperative that a computerized data handling system be utilized. The added complexity involved in developing spatially and temporally resolved estimates of several VOC classes from the basic inventory represents too much work to complete manually. Data handling requirements for inventories used in photochemical models are discussed in References 2 and 8.

2.2.1.11 Quality Assurance

Quality assurance is important in achieving user confidence in an emission inventory. A quality assured inventory will result in a more accurate inventory and lead to better assessment of control strategies and the impact of emissions on air quality. Also, lower program costs may be realized because inventory updates and revisions will not be as extensive as when conducted without a quality assurance program.

A quality assurance program applied to an emission inventory, contains three general types of procedures. Standard operating procedures includes organization planning, personnel training, project planning, and the development of step-by-step procedures for technical tasks. Techniques for finding and correcting inconsistencies and errors includes identification of potential error sources, evaluation of the impact of these sources, location of checkpoints for optimal problem detection, and a provision for timely response when problems occur. The determination of product quality and reliability, in the context of an emission inventory, is the same as data quality assessment. These procedures include a periodic review of the entire inventory process, the development of standards against which to test the accuracy and precision of results, and a system evaluation to maintain optimal resource efficiency.

Standard operating procedures must be outlined as the inventory effort is planned. Identifying and correcting inconsistencies and errors in the inventory can also be anticipated in the planning phase. The quality assurance program is designed to minimize the following potential sources of error.[8]

Missing facilities or sources--Permit and inventory systems out of phase; errors in estimating potential emissions; lost paperwork; problems with computer file updates.

Duplicate facilities or sources--Name changes through corporate acquisitions; use of multiple data sources with different source numbering schemes.

Missing operating or technical data--Ambiguous data request forms; intentional deletion by facility staff; inadequate followup procedures; no preliminary indication of inventory size; or overall inadequate project control.

Erroneous technical data--Misinterpretation of data request instructions; assumed units, faulty conversions, etc.; intentional misrepresentation by the facility; poor handwriting.

Improper facility location data--Recording coordinates of facility headquarters instead of the operating facility; inability of technicians to read maps; failure to observe inventory area boundaries.

Inconsistent area source categories or point source sizes--Failure to designate inventory cutoffs.

Inaccurate or outdated data--Mixed use of primary and secondary data without a policy for standardizing data.

Errors in calculations--Transposition of digits; decimal errors; entering wrong numbers on a calculator; misinterpreting emission factor applications.

Errors in emission estimates--Imprecise emission factors; applying the wrong emission factor; errors in throughput estimates; improper interpretation of combined sources; errors in unit conversions; faulty assumptions about control device efficiency; failure to exclude nonreactive emissions.

Reported emissions wrong by orders of magnitude--Recording the wrong identification code for subsequent computer emission calculations; ignoring implied decimals on computer coding sheets; transposition errors; data coding field adjustment.

The determination of product quality requires the development of procedures to measure the completeness and accuracy of the data file. If a computer data handling system is available, a computer program can perform checks for implausible entries, missing data, and conformity of calculated results with known data relationships. Manual spot checks on the point source records can be performed when computers are not available.

Principles of quality assurance can be applied in planning, data collection, calculations, and reporting of the emission inventory. Quality assurance requires anticipating the measures needed in each of the inventory functions. To promote effective quality assurance, the inventory planner should consider the steps listed below prior to initiating inventory tasks.[15]

1. Planning
   - Plan to allocate resources for maximum quality assurance.
   - Plan to account for significant emission sources.
   - Prepare a checklist of sources to be evaluated.
   - Use staff experienced in data collection and analysis.
   - Plan for routine checking of calculations.
   - Plan for checking data file entries.
   - Prepare data checking programs (when using a computer for data handling).
   - Maintain a separate quality assurance staff.
2. Data collection and analysis
   - Use redundant identification of major sources (quality assurance staff should prepare an independent source list).
   - Check questionnaire design.
   - Check data collected.
   - Check emission estimation methods.
   - Check calculated results.
   - Verify adherence to quality assurance procedures.
3. Data handling
   - Check data file entries.
   - Check individual data entries (missing emissions, SIC codes, addresses, etc.)
   - Assign agency estimates for missing data.
   - Check for data correctness.
   - Review tabulated data for quality.

4. Data reporting

   - Check the aggregation of emissions.
   - Compare results with those of other inventories.
   - Check disaggregation of emissions (if allocated to subcounty areas).

The above is intended to acquaint the user with the concepts and principles of quality assurance. Before planning a quality assurance program, additional information on these concepts and principles must be obtained. Such information on emission inventory quality assurance can be found in References 15 through 17 or can be obtained through an EPA Regional Office. The most effective instruments of quality assurance are the standard operating procedures developed by the agency as these steps determine methods to be used throughout the inventory effort.

2.2.1.12 Documentation

Documentation is an integral part of an emission inventory. Review of the written documentation of an inventory's data sources and procedures by the agency's quality assurance and technical personnel will uncover errors in assumptions, calculations or methods. Remedial actions to correct detected errors will lead to the development of a reliable and technically defensible data base which is essential in enforcement actions, source impact assessments, and development of emission control strategies.

While documentation requirements may evolve during the data collection, calculation, and reporting steps of the emission inventory, these requirements should be anticipated during planning. Planning the level of documentation required will (1) ensure that important supporting information is properly developed and maintained, (2) allow extraneous information to be identified and disposed of, thereby reducing the paperwork burden, (3) help determine data storage requirements, and (4) aid in identifying aspects of the inventory on which to concentrate quality assurance efforts.[8]

2.2.1.13 Emission Inventory Manpower Requirements

To ensure that sufficient resources have been allocated to achieve good results with an inventory effort, cost and manpower requirements should be evaluated in the planning stage of the project. Technical manpower and budget allocations required will be a function of the number and type of sources to be inventoried, the pollutants being inventoried, and the desired data base detail. These inputs, in turn, will be affected by the inventory end use and by the data handling capabilities. Administrative and secretarial support will be a function of the technical manpower and budget allocations determined by all of these factors.[1,18]

Since cost and manpower requirements will vary for each inventory effort, manpower and budget allocations must be determined. When an agency has conducted inventories regularly, its past experience can be used to estimate requirements. A computer model is also available from EPA which estimates technical and administrative costs associated with emission inventories.[8] Information is obtained through EPA Regional Offices or from the Control Programs Operations Branch, Control Programs Development Division, MD-15, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711.

2.2.2 SPECIFIC PROCEDURES

Planning includes a variey of procedures that reflect agency goals and, as a consequence, require management decisions. These decisions address definitional, organizational, and technical problems.[16]

The definitional phase of the planning step is the one in which management defines the system objectives and outlines the basis for meeting those objectives.

1. Define objectives--This procedure requires management to assess the short term and long term goals of the emission inventory program. The purpose of the emission inventory program is to maintain a current and reliable data base which is used to support agency programs for attaining and maintaining air quality. However, specific programs, for example to assess trends in emissions, can be conducted to satisfy specific immediate objectives as well as satisfying the general purpose of the inventory.

2. Define requirements for meeting objectives--Once the major goals of the emission inventory process have been identified, management, with assistance from the technical staff needs to define the types of information required and to take steps to obtain that information. The steps include defining specific data requirements and formats, establishing the authority to obtain and verify the necessary emission data, and defining data quality goals.

The organizational procedures are those that determine the total effort, the resources that will be expended, and the relationship between the inventory process and other agency functions. Procedures must be established that accomplish the following.

1. Relate program and agency functions--This procedure includes an organizational audit to define the purpose of each branch and subgroup within the agency and the level of support that they can and will provide.

2. Assign responsibilities--This establishes the responsibilities and authority of the branch or group for compiling and maintaining emission inventory data. It is an early step in developing a mechanism for establishing the emission inventory. It might also include, for example, an assessment of the degrees of support that branch office operations can provide.

3. Establish communications--This determines the flow of information between management and the subdivisions of the agency. It also establishes the environment for interdepartmental transfer of technical data and support of the inventory and its programs.

4. Assign priorities--This function follows from the assessment by the agency of the scope of its air pollution problems, and the need for the inventory program based on existing air quality and the degree of industrialization or urbanization of the area within its jurisdiction.

5. Budget resources--This function is the logical extention of the assignment of priorities. Budget decisions reflect the expected impact of the emission inventory on agency effectiveness, and they affect the types of inventory procedures that will be adopted.

6. Document procedures--This function is the formal summary of the activities mentioned above.

The technical procedures help to establish the degree of confidence that can be placed in the emission inventory results. They affect the precision and accuracy of the inventory, and the degree to which results can be compared within or among agencies. These procedures are:

1. Develop inventory techniques--This includes decisions about the emission factors to be used, techniques to identify sources, data gathering techniques, manual versus computer data processing, quality assurance programs, and workflow procedures within the organization. These are some examples of a range of complex functions encountered in inventory programs.

2. Develop job descriptions--This includes writing job descriptions for personnel who will be assigned exclusively to the emission inventory process. A written job description will identify skills required to perform the activity; the experience and performance level of personnel; and the training requirements.

3. Identify training requirements--This includes an evaluation of the technical questions that must be addressed in compiling an emission inventory, and the functions requiring special skills or periodic updating of techniques. The training programs and schedules will be designed to aid in incorporating improved inventory techniques and to improve performance of inventory functions.

The end result of planning activity will be a documented program with specific objectives and established priorities for achieving the objectives within a defined time frame and budget. A reasonable program plan relies heavily on input from the definitional phase of task planning; i.e., management objectives, inventory quality goals, etc.

2.2.3 PROJECT SCHEDULES

The Time Requirement Model (TREM) discussed in Chapter 7 allows the manager of an emission inventory to estimate the amount of time required to perform various activities. However, knowledge of the tasks and their estimated time requirements alone is insufficient to conduct the inventory efficiently, or properly allocate the resources available. Modern project management techniques should be utilized to plan, control, and schedule the numerous activities into a cohesive course of action.

The development and maintenance of an emission inventory can be conceptualized as a network of activities that can be mapped out on a chart. The various inventory tasks are defined as individual activities with a definite start and end. The initiation and completion of an activity are denoted by the term "event." Techniques to formulate a project schedule for tasks and events are then utilized.

Program evaluation and review techniques (PERT),* Barcharts (BACH,)* and Critical Path Method (CPM)* are relatively simple methods that are available to identify critical activities and evaluate costs and technical progress. The identification of specific tasks and the logical sequence of activities and their interrelationships within the overall program are useful to both management and the task team in performing the various necessary functions and identifying problem areas and viable alternative plans and schedules.

The scheduling techniques subsection, below, discusses some of the available methods to efficiently organize a project such as an emission inventory. In particular, PERT and CPM are discussed. The task sequences subsection demonstrates briefly how various inventory tasks are scheduled in a progression. Finally, the task schedule subsection shows how the PERT or CPM evaluation methods can be used to determine where "critical sequences" are likely to occur in a series of events.

2.2.3.1 Scheduling Techniques

Standardized techniques used for program scheduling and monitoring include PERT, CPM, and variations. These techniques are fundamentally simple, and this fact heightens their utility. The network or bar chart analysis yields the following advantages for both management and agency personnel:

---

*Further details concerning PERT, BACH, CPM and their variations can be found in References 19 through 24.

For management,

1. More realistic time cost estimates,
2. Improved program control through early detection of uncompleted events, and
3. Good simulation and projection of alternative plans and schedules;

For agency personnel,

1. A better visualization of the individual tasks,
2. Relevant and meaningful interim schedule objectives,
3. Improved communication among agency personnel, and
4. More distinct delineation of task and decision responsibilities.

For the purposes of PERT and CPM techniques, all objectives and goals should be defined. Each activity has definite start and end points that are termed "events" or "nodes." An event has no time duration and serves to indicate the start or completion of an activity. The activities are the links connecting the events, and these have measurable performance times.

Three basic steps are required for PERT or CPM analysis:

1. Develop the network of events from time of start to the completion of the inventory.
2. Estimate the time required to accomplish each activity in the network, using past experience of the manpower/resource allocation model in Chapter 7.
3. Perform analyses of possible schedule problems through the determination of the longest or "critical path" in the network of events.

The PERT and CPM techniques are not meant to perform decision analysis for the manager, but rather allow the manager to develop and order a plan of activities, and to determine the critical aspects of program performance. In anticipating problems and possible delays, the manager is able to formulate effective corrective actions. Viewing the entire project on a network diagram provides a greater understanding of the coordination of activities.

2.2.3.2 Task Sequence

In the formulation of a project schedule, it is necessary to establish the sequence of activities and events using a chronological order to ensure the elimination of conflicts. An understanding of the rational progression of events is necessary for establishing the network of events required to achieve the desired objectives.

The basic sequences of activities for point, area, and mobile source inventories are:

1. For point source inventories:
    a. Identification of inventory data needs;
    b. Establishment of data collection and handling methods;
    c. Development of a source listing;
    d. Development of questionnaires;
    e. Collection and compilation of data, including printing the mailing list and labels, mailing questionnaires, logging and reviewing returns, and questionnaire followup to obtain complete and reliable information.
    f. Assistance to questionnaire respondents;
    g. Transfer of data to the data handling system;
    h. Calculation of emissions;
    i. Quality assurance; and
    j. Presentation of results.
2. For area and mobile source inventories:
    a. Identification of inventory data needs for estimating activity levels and emissions,
    b. Establishment of data collection and handling methods,
    c. Data collection and compilation,
    d. Apportionment of data to desired geographical and temporal levels,
    e. Calculation of emissions,
    f. Transfer of data to the data handling system,
    g. Quality assurance, and
    h. Presentation of results.

The listings of sequential activities presented above are by no means complete. Additional intermediate steps can be included for better resolution of manpower requirements and schedule. However, by inspection of the above listings, the basic sequence of activities is:

1. Identification of data needs,
2. Establishment of methods,
3. Collection of data,
4. Analysis and compilation of data, and
5. Presentation of results.

2.2.3.3 Task Schedules

The use of PERT and CPM is suggested in order to determine the critical sequence of operating and other specific steps most likely to cause delays, and to aid in determining the shortest path (or least time, cost, etc.) to achieve completion of the project. A key feature of these techniques is the use of "milestones" to delineate significant points of development in the inventory process. These milestones include:

1. Initiation of a specific activity,
2. Completion of the activity,
3. Scheduled events (i.e., meetings), and
4. Submission of interim, progress, and final reports. (Typically, these will be oral reports to management and agency groups not directly responsible for the inventory.)

These milestones enable the manager to monitor the progress of each task, and provide the opportunity to adjust or reschedule events in accordance with the milestones. As a project progresses, some changes in activities will occur and new milestones may be designated.

Using the TREM to estimate the number of hours required, values can be assigned to activities between specified events and/or milestones. Two techniques are available for the determination of the "critical path" or longest time required to complete all the scheduled activities. These are the deterministic and the probabilistic approaches. The deterministic approach relies on only one estimate for each activity, and the analysis is then performed. This estimate should be performed by personnel thoroughly familiar with the task. The critical path procedures are then applied to find the longest path through the network. The total time required to complete all project activities is governed by the critical path (i.e., the longest time path linking the initial event and the terminal event of a project). Probabilistic network scheduling requires three time estimates for each activity: optimistic time, pessimistic time, and most likely time. This approach recognizes the uncertainties involved in any project and, in the most pessimistic case, considers the fact that delays in other agency programs may affect the emission inventory development schedule.

Figure 2-2 shows a portion of a network of events A through E and the estimated relative time requirements (in parentheses) of activities 1 through 7. In order to proceed from event A to event E, the various activities will have to be performed. The minimum amount of time required to go from node A to node E can be determined by examining the times required to complete the activities. As an example, in order to proceed from A to D, activity 3 or activities 2 and 6 will have to be performed. The maximum time to complete the AD path is the maximum time required for activity 3 or activities 2 and 6. In this case, the completion of event D is dependent on activities 2 and 6. This process can be expanded to cover the AE pathways, and a critical path determined.

The probabilistic network schedule utilizes three time estimates:

1. Optimistic time (a). The best or shortest time required to complete an activity is estimated.

2. Pessimistic time (b). The longest time that an activity should take is estimated.

3. Most likely time (m). The time estimate which, in the estimator's judgment, has the probability of greatest occurrence.

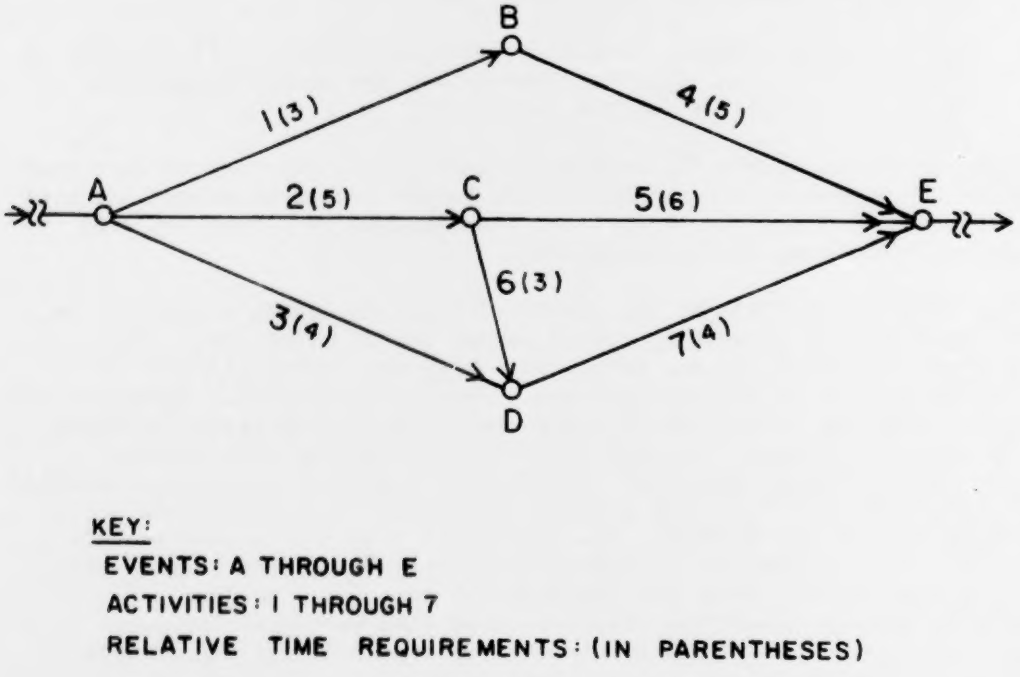


Figure 2-2. Example of a portion of a network.

A single average estimate expression of the expected time to complete an activity is given by:

$$t_e = \frac{a + 4m + b}{6}$$

with $\left(\sigma_{t_e}\right)^2$, a variance in t_e:

$$\left(\sigma_{t_e}\right)^2 = \left(\frac{b - a}{6}\right)^2$$

The expected time, t_e, is a statistical expression with time variance as a measure of confidence of the t_e value. If the variance is small, then the confidence in t_e is high; if the variance is large, then the confidence in t_e is low.

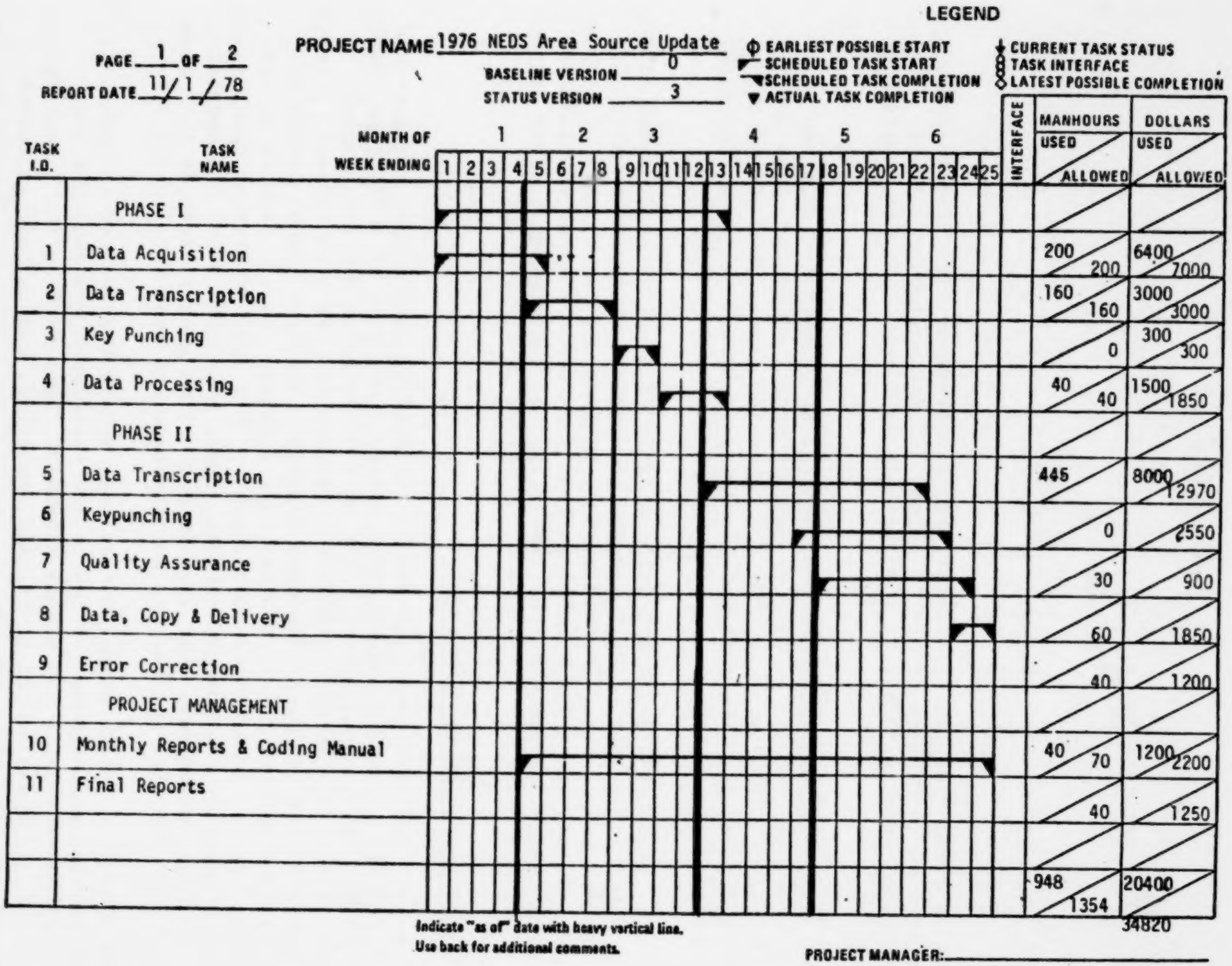
The expected time, t_e, should not be used to actually schedule an activity. However, it can be used to compare with a scheduled value and determine the probability of meeting the scheduled time. This allows the manager to decide the probability of completing a task in a given time within some confidence limits.

Use of the deterministic and probabilistic time estimates in establishing critical paths allows the project manager to schedule or reassign activities as the project progresses. In this manner, optimum use can be made of limited resources. In addition, information derived from CPM/PERT analysis enables the project manager to reassess the feasibility of undertaking a given project task.

2.2.3.4 Example of Project Scheduling

After air quality agency management has decided upon a task sequence and schedule for its inventory effort, this schedule and list of activities should be summarized. Such a summary will not only serve to inform all program personnel of the project schedule of activities, but can also be used to track the progress of the emission inventory program. The most common method of displaying this summary is a graphical task schedule chart. Figures 2-3 and 2-4 present typical program schedule charts. This type of display clearly and concisely summarizes the inventory tasks, their scheduled start and completion dates, and major milestones that must be met. Some charts, such as that shown in Figure 2-3, may also include project manpower and cost data as well.

The project schedule chart is completed before the project is begun. It is based on time and manpower estimates and represents management's best estimate of an achievable and viable schedule. Once work on the inventory has begun, actual progress should be tracked, recorded, and revised as needed. The project schedule chart can also be used for this purpose. Monthly updates on work progress can be superimposed on the original program schedule to reflect actual work progress. Figure 2-4 demonstrates how this updating



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REPORT DATE 11/1/78

PROJECT NAME 1976 NEDS Area Source Update
BASELINE VERSION 0
STATUS VERSION 3

LEGEND

TASK I.D.	TASK NAME	INTERFACE	MANHOURS USED	MANHOURS ALLOWED	DOLLARS USED	DOLLARS ALLOWED
	PHASE I					
1	Data Acquisition		200	200	6400	7000
2	Data Transcription		160	160	3000	3000
3	Key Punching			0	300	300
4	Data Processing		40	40	1500	1850
	PHASE II					
5	Data Transcription		445		8000	12970
6	Keypunching			0		2550
7	Quality Assurance			30		900
8	Data, Copy & Delivery			60		1850
9	Error Correction			40		1200
	PROJECT MANAGEMENT					
10	Monthly Reports & Coding Manual		40	70	1200	2200
11	Final Reports			40		1250
			948	1354	20400	34820

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PROJECT MANAGER:

Figure 2-3. Project schedule with milestones.

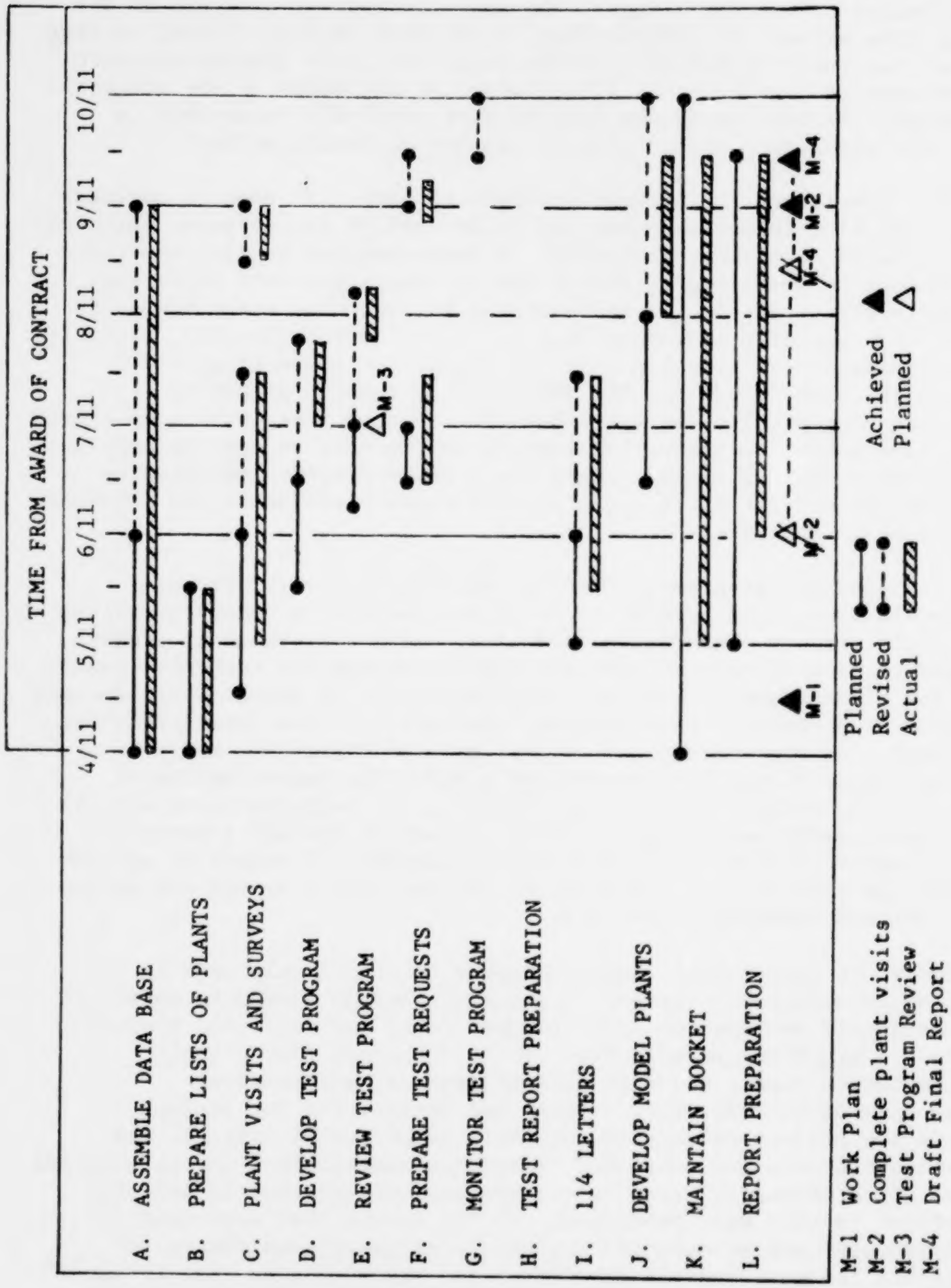

Figure 2-4. Program schedule chart.

technique has been used on a nonemission inventory program schedule. Maintaining a program schedule in this manner provides an excellent historical record of the total work effort. In the short term, it acts as a constant feedback mechanism to program managers who must monitor the progress of the project. In this manner, it ensures that no one task will be allowed to drag on and affect the entire schedule. In the long term, this updated schedule chart can be used to highlight the shortcomings or successes of the original planning effort. Problem areas can then be more carefully researched to ensure that the experience gained will be applied to future projects.

A graphic display of the program schedule is useful in that it outlines the critical and time-intensive tasks and milestones in the emission inventory process that should be closely monitored. A comprehensive quality assurance (QA) program must be developed to ensure use of consistent data gathering, handling, and analysis procedures thus helping to assure an error-free data base. Since each specific inventory task is listed on this display, a quality assurance coordinator can plan his overview checks and inspections to correspond to the task schedule. The frequency of quality assurance inspections can be geared to the scheduled time of each task, with more checks made on the time-intensive tasks. Milestones can be used as quality assurance triggering devices in this regard. When the program display indicates an upcoming milestone for a task, the quality assurance coordinator can increase his surveillance in that area.

A quality assurace program applied to emission inventory project scheduling would have three general types of procedures. Standard operating procedures would include organization planning, personnel training, project planning, and the development of step-by-step procedures for technical tasks. Techniques for finding and correcting inconsistencies and errors would include identification of potential error sources, evaluation of the impact of these sources, location of checkpoints for optimal problem detection, and a provision for timely response when problems occur. The determination of product quality and reliability, in the context of an emission inventory, is the same as data quality assessment. These procedures include a periodic review of the entire inventory process, the development of standards against which to test the accuracy and precision of results, and a system evaluation to maintain optimal resource efficiency.

In summary, to ensure that agency manpower is efficiently used in the compilation of an emission inventory, a project schedule should be developed. This schedule should be based on known project tasks and estimated manpower requirements. A graphical presentation of the inventory tasks, their estimated completion times, major project milestones, and manpower requirements is a useful way of displaying and summarizing the project schedule. As the project is carried out, this graph can be revised, and actual time requirements and completed milestones superimposed on the original projections. By continually tracking the progress of the overall emission inventory effort in this way, management can (1) ensure that each task is being expeditiously carried out, (2) revise its manpower commitments to reflect schedule changes, and (3) learn from its experience so that it can apply this knowledge in future inventory efforts.

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3.0 APPLICATIONS AND USERS

3.1 APPLICATIONS OF THE INVENTORY

An accurate, comprehensive and current emission inventory of all sources can be used for a variety of applications by the air quality control agency. Proper planning and commitment of resources can help ensure that the emission inventory includes all the information needed for the specific, localized needs of the agency.

The specific applications of emission inventory data are many and diverse. Some are set by federal reporting requirements, while others support agency programs and services and are responsive to public concerns. As the compiler of the inventory, and the organization most responsible for its maintenance, the local agency must design the inventory for its own individual requirements. Data obtained from each emission source must be processed, stored and presented in a manner to reflect the priorities of the agency.

All state and local air quality control agencies will have certain common applications of emission inventory information. In this section, the principal uses of inventory data will be discussed. These applications will illustrate how inventory information provides essential input to many air pollution control programs. The applications will be discussed relative to activities commonly found in most agencies.

Planning and Development

- State Implementation Plan (SIP) preparation and review
- Strategies development
- Modeling
- Reasonable further progress (RFP)

New Source Review

- Prevention of significant deterioration (PSD) and emissions offsets
- Environmental impact review

Surveillance and Analysis

- Ambient monitoring network design

Compliance

- Enforcement and compliance

Special Studies

- Trends
- Energy analysis
- Research

The applications listed above and discussed below are not intended to be all inclusive but rather are presented to demonstrate how a well engineered and prepared inventory can serve as a diversified management tool.

3.1.1 STATE IMPLEMENTATION PLAN (SIP) PREPARATION AND REVIEW

State Implementation Plans (SIPs) are developed by state air quality control agencies to ensure that the National Ambient Air Quality Standards (NAAQS) will be met. The plans are required by federal regulation* and address several distinct activities within an overall air quality management program. These typically include ambient monitoring, stationary source emission limitations, compliance schedules, transportation control plans, new source review procedures, and the establishment of air quality maintenance areas (AQMAs) among others. Few agencies had detailed emission inventories at the time the plans were initially prepared in the early 1970's. Consequently, agency management was forced to develop control regulations for source categories without a clear understanding of the actual emisssions from these categories, or the affect each SIP control strategy would have in reducing total pollutant concentrations. The initial SIPs therefore had mixed success in attaining ambient air quality goals. When the Clean Air Act was revised in 1977, Congress recognized the importance of utilizing an emission inventory to systematically assess and control ambient air pollutant levels. SIP revisions for areas which had not yet been brought into compliance are required to provide for the preparation of a detailed emission inventory of that area.** The reasons for this are clear--to reduce emissions, the sources and quantities of emissions must be known. All sources of emissions, including the relatively easily identifiable major point sources, broad based area sources, and the difficult to quantify fugitive emission sources must be included.[1] Once this comprehensive inventory is established, management can accurately assess the effect of new regulations.

This use of an emission inventory to evaluate state regulations and SIPs is as important in attainment areas as it is in nonattainment regions. Management concern with attainment areas involves ensuring that air quality will be preserved. Normal growth in business activity will inevitably lead to a growth in process emissions, and management must plan for this growth and adjust its regulations accordingly. New regulations promulgated on this basis can be justified technically and will be more acceptable to the affected industries and the public in general.

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*Clean Air Act. Section 110, 40 CFR 51--Requirements for preparation, adoption, and submittal of implementation plans.

**Clean Air Act, as amended, November 1977. Section 172 (b)(4).

3.1.2 STRATEGIES DEVELOPMENT

Control strategies are adopted to bring noncompliant air quality regions into compliance and to ensure that regions of compliance retain good air quality levels. Strategies are typically developed by an agency on a pollutant-specific basis. The development of any strategy to limit emissions must use an emission inventory to provide information on the number, location, and size of emission sources, and one or more dispersion models to relate emission rates to air quality pollutant levels. Since proposed control options are frequently expensive to implement, it is important that the evaluation of various control strategies be based on complete and accurate emission data.

The various factors that go into development of a control strategy are presented schematically on Figure 3-1.[2] The emission inventory and control data identify for management the major sources of emission of a particular pollutant under investigation. With this knowledge, management can formulate control strategies which affect one or more source categories and calculate the change in emissions due to each strategy. For example, one control strategy to limit sulfur dioxide emissions might only affect emissions from large, point sources, while a second might concern itself with both point and area sources. Data on all sources must be included in the inventory to provide a sound basis for the assessment of a variety of options and strategies. For each strategy the inventory is adjusted to reflect the effect of the proposed regulation. Once the effect of each strategy on total source emissions is ascertained, the resulting change in ambient air concentration levels must be determined by use of atmospheric simulation models. The agency ultimately decides which strategy will best accomplish its goals after taking into account technical, economic and other factors.

To evaluate various control strategies, an agency planner requires extensive data on the sources emitting a pollutant, including their location, the pollutant emission rate, the type of emission control, and many other source, process, and control equipment related parameters. These data will be available from the inventory in the correct level of detail only if management has had the foresight to anticipate the need in prior inventory efforts. Management must recognize the potential utility of the inventory and ensure that all relevant source data are contained within the inventory.

3.1.3 DISPERSION MODELING

A dispersion model is a mathematical expression that predicts ambient pollutant levels based on source emission rates and meteorological data. Models have been used in agency planning efforts to estimate the effect of the emissions of one source or a group of sources on ambient air quality. As such, they represent an integral part of such programs as air quality strategy development, air quality maintenance area planning, new source review programs, and the prevention of significant deterioration (PSD) determinations. A number of air quality dispersion and simulation models have

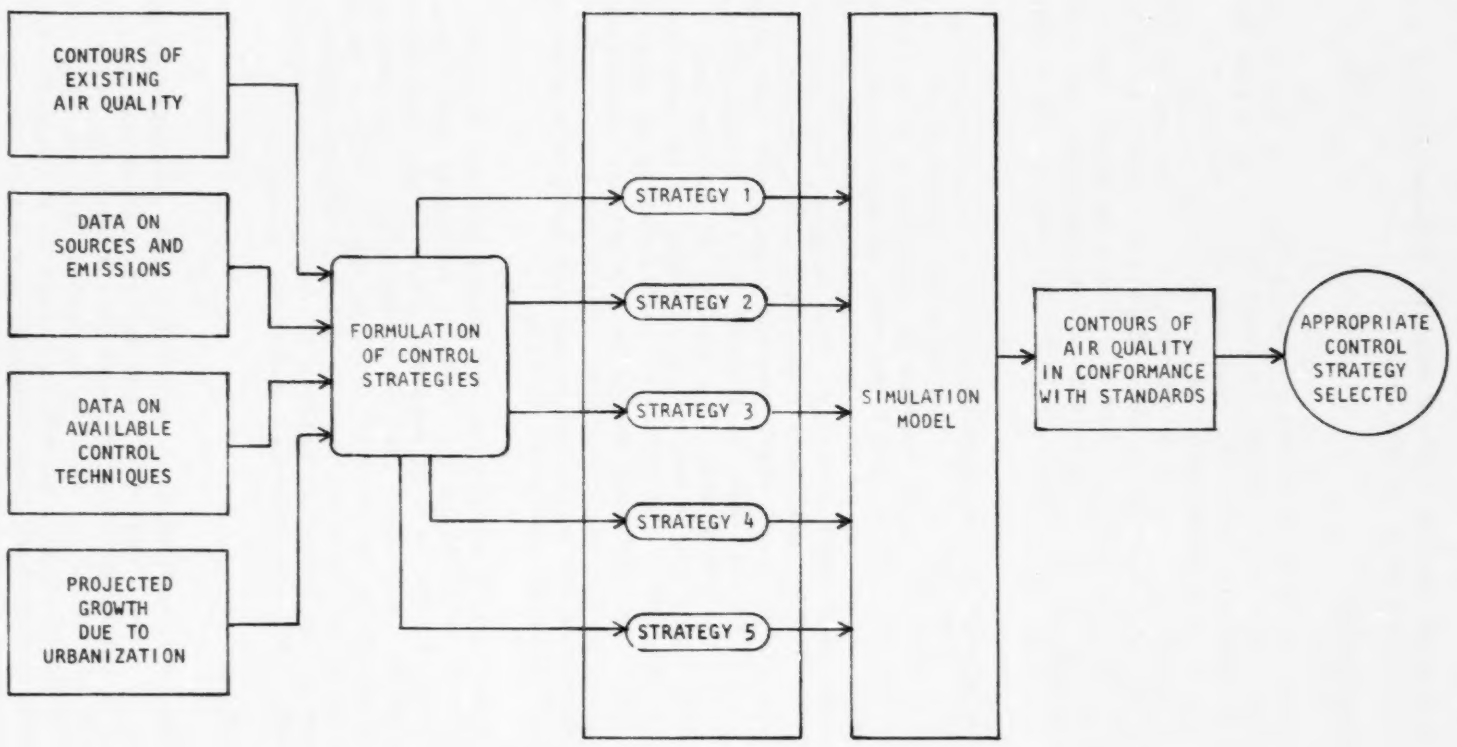
CONTOURS OF EXISTING AIR QUALITY
DATA ON SOURCES AND EMISSIONS
DATA ON AVAILABLE CONTROL TECHNIQUES
PROJECTED GROWTH DUE TO URBANIZATION
FORMULATION OF CONTROL STRATEGIES
STRATEGY 1
STRATEGY 2
STRATEGY 3
STRATEGY 4
STRATEGY 5
SIMULATION MODEL
CONTOURS OF AIR QUALITY IN CONFORMANCE WITH STANDARDS
APPROPRIATE CONTROL STRATEGY SELECTED

Figure 3-1. Flow diagram for the development of a control strategy.

been developed.[3,4] The models differ from each other in a number of ways. These include the number and type of sources they handle (point, area, line, etc.), the spatial and temporal resolution of pollutant emission rates, the averaging time for which they estimate ambient concentrations, the number and type of pollutants for which they can compute average concentrations, and the manner in which they adjust for the topography of the area under investigation. With so many variables involved, most models are only used in specific, limited applications.

At a minimum, all models require substantial source data. For a point source, these data include the location of the source, stack height and diameter, the velocity and temperature of the flue gas emissions, and the release rate of the pollutant emission. The dispersion model will use these data to predict ground level pollutant concentrations.

Because of the many variables involved in the use of dispersion models, management must know not only if they are going to use a model, but must be able to identify the specific model and its data requirements. This is especially true with regards to the temporal resolution of pollutant emission rates. Will an emission inventory that reports emissions on an annual basis be sufficient? Should it be seasonal? Monthly? Hourly? Management must either choose a model whose requirements are consistent with the level of detail of the inventory or upgrade the inventory to provide the additional information required by the model.

3.1.4 REASONABLE FURTHER PROGRESS (RFP)

A regulatory mechanism which Congress added to the Clean Air Act in 1977* is Reasonable Further Progress (RFP). RFP utilizes annual changes in pollutant emission levels, as reported by the emission inventory, to measure the success of the SIP in meeting its goals in nonattainment areas. As such, it serves to verify that the control strategy adopted to bring a nonattainment area into compliance is accomplishing its objective. Should RFP indicate that progress is not being made, the state agency can alter its SIP to include more extensive emission control regulations. Reasonable Further Progress is notable in that it uses the emission inventory, for the first time, to measure the effectiveness of a state implementation plan. The RFP mechanism implies that by planning for, measuring, and keeping track of reductions in an emission inventory, a state agency can ultimately bring areas into compliance.

RFP consists of two parts. First, a schedule is developed which indicates total pollutant emissions (in tons per year) for a base year and the projected emission level in 1983 that the agency believes will result in compliance for the nonattainment area. The 1983 target date has been set by Congress.** The purpose of this schedule is to verify that the emission reductions obtained are being accomplished at a reasonable and efficient rate so that attainment by the prescribed time will take place. The second part of RFP involves tracking the yearly reductions in actual emission inventory pollutant levels. These reductions will come about as a result of the increased controls mandated by the SIP in the nonattainment area. These annual incremental reductions are then compared with the predetermined schedule to determine the success of the SIP in this area. If the scheduled reductions are not met, then the state agency must adopt additional measures to reduce emissions. These might include increased enforcement, a stricter new source review procedure, or more stringent emission limitations. The entire mechanism of RFP schedules and tracking is explained in detail in Reference 2.

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*Clean Air Act, as amended, November 1977--Sections 171(1) and 172(b)(3).

**Clean Air Act, as amended, November 1977--Section 172(a)(1) and (a)(2).

The use of an emission inventory in RFP schedules and tracking is mandatory. The inventory must be established for all sources which contribute to the nonattainment pollutant. Fugitive point and area source emissions can be very significant but may easily be overlooked. A true assessment of the effect of emission reduction on air quality cannot be made if all significant sources are not included in the inventory.

The inventory must be updated on an annual basis. Rather than make this annual emission inventory a separate effort for nonattainment areas, state and local agencies may decide to incorporate this work into an overall emission inventory program for all areas within the agency's jurisdiction. Sources in nonattainment areas will be segregated, as required, through the use of an area quality control region (AQCR) identifier code attached to the source records in the emission inventory.

3.1.5 PREVENTION OF SIGNIFICANT DETERIORATION

The Prevention of Significant Deterioration (PSD) is a congressionally mandated policy* which is designed to protect the air quality in regions now meeting National Ambient Air Quality Standards (NAAQS). The method established for preventing the significant deterioration of air quality is a preconstruction review of large new plants whose emissions will affect regions of the country that are currently complying with NAAQS. The PSD rules apply to a facility if (1) the plant is located in an area that is in compliance with any NAAQS, (2) the potential emissions from the source of any regulated pollutant exceeds 100 tons/year and the facility is in one of the 28 industrial categories listed in Table 3-1 (or for all other industrial categories if the potential emissions exceed 250 tons/year), and (3) the plant commenced construction on or after March 19, 1978. If these criteria are met, the facility is required to undergo a preconstruction review by the state air quality agency.

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*Clean Air Act, as amended November 1977--Sections 160-169.

TABLE 3-1. PSD INDUSTRIAL CATEGORIES

Fossil-fuel steam electric plants of more than 250 million Btu per hour heat input

Coal cleaning plants (thermal dryers)

Kraft pulp mills

Portland cement plants

Primary zinc smelters

Iron and steel mills

Primary aluminum ore reduction plants

Primary copper smelters

Municipal incinerators capable of charging more than 250 tons of refuse per day

Sulfuric acid plants

Nitric acid plants

Petroleum refineries

Lime plants

Phosphate rock processing plants

Coke oven batteries

Sulfur recovery plants

Carbon black plants (furnace process)

Primary lead smelters

Fuel conversion plants

Sintering plants

Secondary metal production facilities

Chemical process plants

Fossil-fuel boilers of more than 250 million Btu per hour heat input

Petroleum storage and transfer facilities with a capacity exceeding 300,000 barrels

Taconite ore processing facilities

Glass fiber processing plants

Charcoal production facilities

Source: 40 CFR 51.

The chief components of the PSD review include (a) an area classification system, (b) increments of air quality, and (c) best available control technology (BACT). The area classification system was established for all clean air regions to allow a moderate amount of industrial growth in all areas but not allow industrialization to degrade air quality to the point where air quality standards were jeopardized. All areas are classified Class I, Class II, or Class III. States can reclassify areas to allow for increased industrialization with public approval. Class I areas include the most pristine areas of the country, such as many National Parks. Facilities whose emissions impact these areas are subject to the greatest emission control. Class II areas are areas of moderate growth and Class III areas are areas of major industrial activity. Areas can only be designated Class III after a public hearing.

For each area classification, PSD defines the increments of additional pollutant (particulate and sulfur dioxide) that are allowed in an area due to the effects of all new growth in that area. These increments are shown in Table 3-2. As can be seen from this table, only small, incremental increases will be allowed in the Class I areas. This will ensure that these existing clean areas will maintain their relatively high level of air quality. If an area were to be changed to Class II, additional growth and a higher pollutant increment would be permitted provided the NAAQS were not exceeded.

TABLE 3-2. AIR QUALITY INCREMENTS

Pollutant[a]	Area designation Class I	 Class II	 Class III	Primary ambient air quality standard
Particulate matter				
Annual geometric mean	5	19	37	75
24-hour maximum	10	37	75	260
Sulfur dioxide				
Annual arithmetic mean	2	20	40	80
24-hour maximum	5	91	182	365
3-hour maximum	25	512	700	1,300

[a] All units in micrograms per cubic meter.

Source: 40 CFR 51.

In specifying an incremental measure of air quality deterioration, Congress, in the Clean Air Act, implied the use of dispersion modeling and emission inventories. Thus, sufficient data for dispersion modeling must exist in the inventory for all sources, including new and modified sources. Once the source record is established, it can be used for additional emission inventory related applications. The PSD program, in fact, requires that the agency keep close track of all sources that are applicable to PSD review. The agency must quantify the cumulative effect of all new sources on ambient air levels. The emission inventory should be used to store these new source records, with some easily identifiable code assigned to PSD related sources. As each new PSD source is reviewed, all similar sources can be extracted from the inventory so that the net affect on ambient air quality of all sources can be ascertained through the use of a dispersion model.

To ensure that the increments are not quickly expended, the Clean Air Act specified that each major new source install best available control technology (BACT). BACT is determined for each industry on a case by case basis and will not be discussed in detail here (see Appendix A for a definition of BACT). This BACT requirement should be identified on the source emission inventory record.

3.1.6 OFFSETS

While PSD regulations are concerned with new construction in clean air attainment areas, the Emissions Offset policy involves new construction or substantial modification of facilities in nonattainment areas. This policy was originally issued by the EPA in its interpretative ruling* and subsequently made a requirement of all SIP Revisions for nonattainment areas.**

The Offsets policy essentially states that no major source can be constructed in an area where there is a NAAQS violation unless it obtains a permit. This permit imposes stringent control requirements including emission reductions or "offsets" that are larger than the emissions produced by the new facility. This program ensures that any major facility constructed in a nonattainment area will "offset" more emissions than it will produce and the entire airshed will see a net reduction in emissions due to the construction of the new source.

Since state agencies are charged with the administration of the Offsets policy, each state will define which sources will be regulated. Typically, new sources with actual emissions exceeding 50 tons/year, 1000 lb/day, or 100 lb/hr of particulate, sulfur oxides, nitrogen oxides, volatile organic compounds, or carbon monoxide will be affected.

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*Federal Register 41, December 21, 1976. pp. 55524.

**Clean Air Act, as amended, November 1977. Sections 172-173.

Imposition of the Offsets policy requires that the owner of a proposed facility find a source where an emission reduction can be effected. This may be within his own plant, at another industrial facility, or at a government facility. The emission inventory is the most direct vehicle for identifying the location and amount of emission reductions available from a source. Management, however, must plan its inventory data system to provide for this capability. In addition to the standard facility data stored in the inventory, a space on each facility record must be devoted to actual or potential emission offset. Facilities which realize emission reductions due to the closing down of a process or the installation of less polluting equipment can then register these reductions with the agency. These offsets can be maintained within the inventory to expedite review procedures for major new sources in nonattainment areas.

3.1.7 ENVIRONMENTAL IMPACT ANALYSIS

Environmental Impact Analysis is a regulatory tool used to assess potential environmental effects that result directly or indirectly from the construction of new projects. For projects involving federal funding, the analysis is required by the National Environmental Policy Act (NEPA).* Many individual states have passed legislation which requires similar environmental analysis for state-funded projects. These environmental reviews are contained in Environmental Impact Statements (EIS). These statements must identify and discuss the environmental effects of the proposed action and analyze and compare alternatives. The applicability of these reviews is not explicitly spelled out in the law and is often decided by the courts. Projects for which an EIS is usually required include energy projects, dams, highway construction, subsidized housing, shopping centers, and industrial park developments. An EIS must concern itself with all environmental factors including air and water quality, solid waste generation and disposal, odors, and ambient noise levels. Only the air quality related aspects of an overall environmental impact analysis will be discussed here.

To review the effects of a new source on local air quality, an agency must first determine ambient air quality levels at the project site using, if available, data from local ambient monitoring stations. The impact of the project on these levels must then be determined. To do this, source emission data of the detail contained in an emission inventory must be obtained. These data should include not only pollutant emissions generated directly by the project itself, but also increased emissions brought about by the projects secondary impacts such as increased vehicular traffic and fugitive dust emissions. Once quantified, these pollutant mass emission rates are used with dispersion models to predict the overall effect of the project on local ambient air quality. The use of a dispersion model in this application establishes the amount and detail of emission data that are required. In addition, for impact analysis projects, the expected growth of emissions must be estimated to determine the project's effect on long term air quality maintenance. The quantification of all short and long term pollutant emissions that is required for this review will also help agency management define any additional regulatory actions (i.e., NSPS, NESHAPS, PSD, Offsets) that are applicable. All relevant federal, state, and local air quality regulations must be listed and the actual or projected status of all pollutants determined. If the project involves secondary impacts, these must also be quantified and added to the source's emission inventory record. Finally, fugitive emissions that may result from the proposed action must be calculated. When completed, a comprehensive emission inventory profile or the proposed project will be available. A similar source record must be developed for each proposed alternative that is addressed in the impact statement. When all emission related data have been quantified, the entire data set for each alternative is modeled separately to ascertain the effects on local ambient air quality. The various inventory source records are retained until the project is completed, and the source records for the selected alternative are added to the inventory.

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*40 CFR 1500-1508.

3.1.8 AMBIENT MONITORING NETWORK DESIGN

The emission inventory can be used to design ambient air monitoring networks. Ambient air quality monitoring is a vital element in state and local air quality programs to establish the compliance or noncompliance status of state, county, or air quality control region with respect to NAAQS.[5] The accuracy of the ambient air quality data that are obtained and the representativeness of the monitoring sites seriously impact on the usefulness of the agency's air quality control programs.

The documentation of population exposure to ambient pollutant levels is the single most important aspect of an ambient monitoring network. However, there are a host of agency programs which need monitor data support. These programs include those to:

Evaluate ongoing and planned control strategies;

Determine background concentrations;

Develop or revise national control policies for criteria and other pollutants (includes New Source Performance Standards (NSPS), tall stacks, and Supplementary Control Systems (SCS));

Provide data for model development and validation; and

Document pollution episodes and initiate episode controls.

The establishment or optimization of an ambient monitoring network to provide support for these programs is an important task for management. The design of this optimum network includes retaining representative existing sites as well as selecting new sites. As this network will determine the compliance status of the area, it must be designed in accordance with federal requirements.* Information which must be considered in this network design include (1) existing and future plans for land use, (2) traffic counts and other transportation data, (3) demographic statistics, (4) meteorological data, (5) geographical information, and (6) existing air quality data.

Geographical placement of the monitoring site to accurately determine pollutant concentrations can only be accomplished by detailed analyses of large amounts of background information for the area under consideration. Emission inventory data are necessary input to an air quality dispersion model which can be used to estimate the impact of sources on selected geographical areas. The selection of a model which is most appropriate for the area under investigation will establish the level of detail that the emission inventory must satisfy. Specifically, the number of sources to be included, and their spatial and temporal resolution will be set by this dispersion model. The predicted air quality impacts, in concert with demographic patterns, are then used to select the monitoring sites which satisfy conditions for the maximum number of agency programs. The use of an emission inventory can also aid the agency in siting monitors which measure the impacts of a few selected sources; for example, to monitor the impact of facilities which have been allowed to convert to a higher sulfur oil or coal, as part of a SIP revision.

In cases where no dispersion model analysis is available, techniques do exist for using only the emission inventory in the site selection process. Methods such as the manual plotting of plumes downwind of major sources based upon the prevailing wind direction are outlined in detail in the site selection manuals published by EPA for the criteria pollutants.

3.1.9 ENFORCEMENT AND COMPLIANCE

Agency enforcement and compliance activities have a direct dependence on air pollution control emission inventory data. These programs encompass a variety of actions which concern themselves with individual emitters of pollutants. Items such as scheduled annual source inspections, source sampling, plant visits in response to citizens complaints, and observed visible emission violations require agency personnel to have a detailed knowledge of a facility, its process operations, and its emission rates. These data are included in an emission inventory and can be used to support enforcement and compliance activities. However, agency compliance actions require additional data that are not normally kept in an inventory. For example, enforcement case histories and the establishment of compliance schedules draw upon past inspection reports and notices of violation that are not normally maintained with the emission inventory. Because there is such a strong interaction between the inventory and compliance-related activities, management must plan for the continued, easy exchange of data from one activity to the other.

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*40 CFR 58.

This exchange of information can work both ways. Compliance activities that draw upon inventory data can also serve to verify and update that data. New information on a source that is obtained as a result of the issuance of a permit or the inspection of a facility should be included in the emission inventory. This internal updating mechanism will ensure that the agency is utilizing the latest available source information.

In spite of the inherent disadvantages an agency may face attempting to incorporate all source data, including compliance records, into one control file, management may choose this approach. Agencies which have automatic data processing equipment can place some or all of their source records on a computer. One such system that is currently used by many agencies in this manner is the Emission Inventory System. This system consists of the Emission Inventory System/Point Source (EIS/PS)[6] and the Emission Inventory System/Area Source (EIS/AS).[7] It was developed by EPA to integrate emission inventory and permit data. The computer programs required are maintained (updated) by EPA and the system is available to state and local air pollution control agencies at no charge. Many individual state agencies have their own computerized system which similarly combine emission inventory data with other internal agency program requirements.

3.1.10 EMISSION TRENDS

Emission trends, in conjunction with ambient air quality trends, enable management to adjust their planning and enforcement activities to changes in source pollutant emissions within an area. The increases or decreases in mass emissions may be plotted for any subdivision of the entire inventory; e.g., specific "critical" areas, industrial categories, source sizes, etc. When coupled with ambient air quality data, emission summaries provide a measure of the cause and effect relationship between local source emission rates and measured ambient pollutant levels.

Emission trends analysis has historically played a role in evaluating pollutant control strategy selection. In the case of pollutants with easily documented origins, such as sulfur dioxide, emission inventory trends have been used to verify the effect of imposing specific control strategies on actual ambient air quality levels. This relationship can then be used in future planning and strategy development efforts. For pollutants that have a diversified industrial origin such as hydrocarbons, emission inventory trends also indicate the success (or failure) of imposing tighter emission controls, although the correlation between reduced source emissions and measured pollutant levels may not be as easily definable or traceable. For all pollutants, trend analysis helps pinpoint those emission sources or categories that are growing faster than others. Management can use this information in periodic revisions of implementation plans to avoid ambient air quality violations.

3.1.11 ENERGY ANALYSIS

Emission inventories play an important role in energy analyses because they contain energy use data for all stationary sources. The type of fuel utilized by a facility and the fuel ash and sulfur contents are recorded in the inventory and updated on an annual basis. In addition, each facility that is included in the inventory is identified by one or more industrial indicators. The Standard Industrial Classification (SIC) Code classifies the source by its industrial type (e.g., chemicals and allied products, primary metal industries, etc.). The Source Classification Code (SCC) identifies the specific production processes used within the source and the size range of this equipment. These codes can be used by the agency to segregate individual industries from the total inventory for the purpose of conducting an energy analysis. For example, if industry in an area wishes to convert its oil-fired boilers to coal firing, the agency can extract all potentially affected units (e.g., boilers with capacities in excess of 100 million Btu/hr) from the inventory using SIC and SCC codes. Annual fuel oil use can be tabulated from these individual source records and estimates of ambient pollutant contribution can be made for the entire category using emission factors to determine changes in pollutant emissions resulting from conversion of oil to coal. For complex scenarios, energy use data can be used with dispersion models to predict changes in ambient air quality levels. The emission inventory permits the agency to calculate the effect of any proposed energy strategy and in certain areas may permit the agency to revise its SIP to allow the use of cheaper fuels without exceeding ambient air quality standards.

3.1.12 RESEARCH

Emission inventories have played an integral part in many air quality related research efforts. These investigations have been conducted by state and local agencies, universities, private contractors, and the federal government. Their subjects have ranged from the local effects of one source's emissions to studies which utilize emissions from all sources over a multistate region. The emission inventory is the definitive source of data for studies which attempt to correlate emissions with environmentally related data such as population disease rates. This use of the inventory to correlate pollutant cause and effect relationships helps define national policies and transcends its use in day-to-day agency programs.

State and local agencies may use inventories for such purposes as point source model validation or industrial energy density comparisons. Model validation studies involve applying comprehensive emission and meteorological data to a dispersion model and recording the predicted air quality levels at specific receptor points which are usually ambient monitoring sites. The measured ambient air quality at these sites is then compared with the predicted concentrations. The difference between predicted and measured values is an indication of the accuracy of the model for the specific application under investigation.

Research into the causes of an ambient air quality violation may prompt an agency into conducting an extensive review of emissions from sources in the area surrounding the monitoring site. These investigations begin with a study of emission inventory data for all sources in the area and can progress to investigations of additional emission related factors such as daily weather patterns, traffic counts, street cleaning, and construction activity that are not part of the inventory data base.

The federal government, its contractors, universities, and independent organizations use state emission inventory data to support multi-state investigations. For example, the Northeast Corridor Regional Modeling Project conducted by EPA (1980 to 1982) utilized emission inventory data to quantify the level of interurban transport of ozone in the broad area from Washington, D.C. to Boston. Emission inventories for all states in the study area were combined to help develop and validate a regional scale photochemical dispersion model to characterize pollutant generation and transport through the northeast and to analyze various oxidant control strategies.

A similar study was undertaken by the Electric Power Research Institute (EPRI). This organization in its Sulfate Regional experiment (SURE)[8] focused on the nature of sulfur oxide behavior in the eastern United States. Extensive emission inventory data were collected from utilities in an attempt to derive a quantitative method for relating emissions from the electric power industry to regional ambient air quality as measured by sulfur dioxide and particulate sulfate levels.

3.2 USERS OF THE INVENTORY

Emission inventory data are potentially useful to anyone requiring information on air pollutant emitting sources. The source, location, type, and amount of pollutant discharge as well as the type of industry, process rate, and energy consumption of any facility or group of facilities can be obtained from standard inventories. Through the use of automated data processing equipment, source data can be sorted by any single identifier or group of identifiers, such that specific user oriented reports can be generated. The list of actual emission inventory users is therefore quite extensive and covers a wide range of public and private institutions. A review of some of these users will serve to illustrate the extent of emission inventory use.

3.2.1 STATE AND LOCAL AGENCIES

The most common users of emission inventories are the state and local air pollution control agencies. Inventories represent an integral part of their control programs and are used continuously for a variety of internal applications. Emission inventories provide technical support for the range of agency programs that have been previously described in this section. The key factor in an agency's use of the inventory is planning. Management must plan the inventory for all potential applications and ensure that the scope and detail of source information contained in the inventory are sufficient for the intended applications.

Other state and local agencies may use emission inventories for their projects. Planning agencies concerned with air emissions from a new stationary source such as a power plant, or a traffic-inducing source such as a shopping center, will consult inventory data prior to issuance of a ruling. Local conservation commissions require inventory input when examining items such as solid waste disposal proposals or industrial expansion projects. Agencies concerned with health problems are likely to contact air quality control agencies for information on major emitters of various pollutants. All agencies concerned with the effect of its actions or proposed actions on air quality can make use of the emission inventory. A comprehensive inventory can also be used by the agency to evaluate the variety of decisions made by others, including adjoining states and federal agencies, which may directly affect the state or local jurisdiction and its people in a significant way.

3.2.2 CITIZEN USE

Air quality control agencies are established to serve the general population. The agency protects the health of its citizens and is ultimately responsible to them. Thus citizens have a right to know how the agency functions, and what information is used to support agency actions. Through public hearings, citizens can participate in the agency's decision making process. Among the responsibilities the agency has to these citizens is to allow them open access to emission data such as that contained in an emission inventory. The air quality control agency should serve these citizens by maintaining an accurate and easily accessible emission inventory.

3.2.3 GOVERNMENT CONTRACTORS/INSTITUTIONAL

Consultants and universities will use inventory data primarily for research efforts. Their data needs are governed by the complexity of the investigation and the requirements of any dispersion model to be used in each study. In this regard, they act much like the control agency in their data needs and the level of detail required.

3.2.4 FEDERAL (NON-EPA)

In addition to EPA, several federal agencies draw upon the source data available in the emission inventory. Their use for this data is commonly for preparation of an Environmental Impact Statement. Federal agencies are required to file impact statements on new major construction under their jurisdiction that could have a potentially adverse impact on the environment. The air impact analysis section of these impact statements draws upon emission inventory data to quantify air quality levels.

In addition, many federal agencies use emission inventory information in miscellaneous internal studies. The Department of Energy utilizes specific energy user lists for general reporting purposes, summarizing energy use patterns and providing energy use trend reports. The Department of Transportation utilizes mobile source information taken from the emission inventory in its planning process for highways and airports. The Department of Housing and Urban Development will use inventory data in residential heating studies. The Departments of Interior and Agriculture can use inventory data for assessment of industrial categories of concern to them. Any governmental planning agency that must consider environmental affects of a proposed action is a potential user of emission inventory data. In order to make environmentally correct decisions, they must have a reliable, accurate source of air pollutant emission information. An accurate, current, and comprehensive emission inventory of all sources will provide these data.

References for Chapter 3.0

1. Criteria for Approval of 1979 SIP Revisions, OAQPS 1.2-095, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1978.

2. Workshop on Requirements for Nonattainment Area Plans, OAQPS 1.2-103, Volume 19, U.S. Environmental Protection Agency, Research Triangle Park, NC, January 1979.

3. Workbook for Comparison of Air Quality Models, EPA-450/2-78-028a, U.S. Environmental Protection Agency, Research Triangle Park, NC, January 1979.

4. Turner, D. B., "Atmospheric Dispersion Modeling, A Critical Review," Journal of the Air Pollution Control Association, 29(4):502-519, April 1979.

5. Guidelines for Air Quality Maintenance and Planning and Analysis, Volume XII: Applying Atmospheric Simulation Models to Air Quality Maintenance Areas, EPA-450/4-74-013, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1974.

6. The Emission Inventory System/Point Source User's Guide, EPA-450/4-80-010, U.S. Environmental Protection Agency, Research Triangle Park, NC, May 1980.

7. The Emission Inventory System/Area Source User's Guide, EPA-450/4-80-009, U.S. Environmental Protection Agency, Research Triangle Park, NC, May 1980.

8. EPRI Sulfate Regional Experiment: Results and Implications; EPRI EA-2077-SY-LD, Project 862-2, September 1981.

4.0 INVENTORY DATA REQUIREMENTS

In order to formulate decisions for pollution control or reduction strategy, some basic information concerning sources and emissions is required. The emission inventory file serves as the repository for this information. The amount of information and the detail or resolution of the inventory data should be consistent with the intended use. However, a comprehensive inventory, of the detail described in this manual, should be maintained by the agency to satisfy both regulatory and functional requirements. A goal of emission inventory planning is to obtain and maintain within the inventory the level of source and emission data that is needed for all anticipated uses of the inventory. Air quality dispersion modeling, more than any other agency activity, will determine the level of temporal and spatial resolution of the data maintained in the emission inventory file. Background documents on each dispersion model should be consulted to determine the specific temporal and spatial resolution requirements of each.

Automatic data processing is strongly suggested to handle the large amount of data that are needed for the comprehensive inventory.[1] Various programs can be initiated that will facilitate data edit checks and sort and report data according to desired pollutants, source categories, etc.

It is not always necessary to conduct an inventorying activity that includes all of the criteria pollutants. Rather, one pollutant, for a number of reasons, may present a more serious problem than another and be subjected to more detailed analysis. Thus, the scope of a specific agency program may require an inventory effort that can be restricted to cover only those point, area or mobile sources that are directly related to the pollutant of interest. This is possible for the pollutants, SO_x, NO_x, hydrocarbons, carbon monoxide, particulate matter, and lead which are now maintained in the emission inventory file. Additional hazardous pollutants may be of interest to the agency and, if possible, the inventory should be expanded to include these pollutants.

The grouping of emission sources into categories is done to identify the major sources of emissions and assist in the development and assessment of control strategies. At a minimum the agency should be prepared to report source and emission data from those categories shown in Table 1-1. More detail is desirable and made mandatory by regulation in many situations.

The comprehensive inventory is comprised of three types of sources: point sources, area sources, and mobile sources. Point sources consist of identifiable points of emissions that release pollutants into the atmosphere, usually greater than 100 tons per year of any pollutant. Area sources consist of a number of smaller sources, not classified as point sources, which are defined by geographic boundaries and engaged in a specific activity that provides a means of estimating the collective emissions from the sources. Mobile sources are nonstationary emission sources, including both highway and off-highway transportation sources. Emissions from mobile sources result from fuel combustion and crankcase and certain other evaporative VOC emissions.

4.1 POINT SOURCES

The point source is an individual, stationary source of emission that is maintained in the point source file. Emissions are the result of process operations and a facility or plant may contain several emission producing operations which can be vented to one or several point sources of emission. The inventory of point sources can be considered to be much more accurate than an area source or mobile source inventory. This accuracy is due to the detail required for characterizing and analyzing the operations of each point source. Because more detailed information is obtained concerning the process throughputs, process parameters, and operating schedules, emissions can be estimated more accurately and with greater geographical and temporal resolution.

Any source emitting in excess of 100 tons per year of any criteria pollutant is generally considered a point source. However, there is no uniform use of that emission rate limit. The higher the cutoff limit, the fewer the facilities that are included in a point source inventory; a lower limit would result in the inclusion of more sources.

The point source inventory has three levels of complexity. In order of increasing complexity they are: the plant level, which denotes a plant or facility that could contain several pollutant emitting activities; the process level, representing the unit operations of specific source categories; and the point level, where emissions to the ambient air from stacks, vents, or other points of emission are characterized. Information concerning the preparation of point source inventories is presented in Volume II of this series.[2].

4.1.1 PLANT LEVEL

The first step in preparing an inventory of point sources is to collect information which identifies plants or facilities which contain one or more point sources of emission. Each plant identified within an area is assigned a plant number and it is further identified by geographic descriptors such as air quality control region, state, county, city, street and/or mailing address and UTM grid coordinates (or latitude/longitude). A plant personnel contact should also be identified to facilitate communication and interaction with the plant. Additional information gathered regarding the facility are annual fuel consumption, process throughput, hours of operation, number of employees and the Standard Industrial Classification (SIC) code of the plant. SICs are prepared and published by the Office of Management and Budget of the U.S. Government. A given facility will have only one SIC denoting the principal economic activity of the facility.[3]

4.1.2 PROCESS LEVEL

A plant can consist of various processes or operations. Each process can usually be identified by an EPA source classification code (SCC) which has associated with it an SCC emission factor to allow calculation of emissions from specific process operations and equipment.[4,5]

The information necessary for the establishment of an inventory at this level includes source identification information (as previously described for plant level); the periods of process operation (daily, weekly, monthly, annually); operating rate data, including actual, maximum and design operating rate or capacity; fuel use and properties data (ash, sulfur, trace elements, heat content etc.); and identification of all pollution control equipment and their associated collection efficiencies (measured or design).

Emission estimates should identify the estimation method used; e.g., actual stack sampling, material balances, emission factors, engineering analysis, or other estimation techniques. All assumptions, procedures, and analyses should be documented to provide sufficient information for evaluation of the procedures used and the resulting emission estimates.

4.1.3 POINT LEVEL

Each stack, vent, or point of emission which meets or exceeds the specified point source emission rate designation is identified as a point source within a plant. Information obtained from the point source inventory level is utilized in the design, testing and application of mathematical models for the correlation of air pollutant emissions with ambient air quality.

Basic information such as location (UTM Coordinates), stack height of the emission point, diameter of the stack, emission rate , method of determination, gas exit velocity from the stack, the efficiency of control equipment, and emission rates during normal and upset conditions, are parameters necessary for establishment of a comprehensive inventory and for modeling programs. For modeling, the precision required in specifying the position of a source is partly related to the position of the receptor. Some dispersion modelers concerned with the impact of a point source on nearby receptors have asked that the location of point sources be determined within 10 meters.

Although such a high degree of precision in specifying location may only be necessary in a limited number of applications, it is recommended that the location of point sources be reported with a resolution of at least 100 meters. This level of resolution represents that specified for the existing data in the National Emissions Data System (NEDS).

4.2 AREA SOURCES

An area source represents many sources of emissions which are too small to be classified as point sources and for which data are maintained collectively in the area source inventory. Although these sources may individually emit only small quantities of pollutants, the collective emissions may have a significant impact on air quality. Mobile sources are regarded as area sources. However, mobile sources are inventoried separately from stationary area sources.

The area source data file is needed to provide a record of source and emission data for categories of sources that are small and too numerous (e.g., residential heating units) to include in the point source file. Area source emissions for a category are estimated by multiplying an emission factor by some known indicator of collective activity for the source category which can be correlated with emissions; e.g., fuel burned is the activity factor used for home heating units. The selection and structuring of area source categories, in addition to providing a means for the collective estimation of emissions from the category, determines the type and amount of data that are maintained in the area source file and the usefulness of the inventory in agency activities, such as assessing the effects of control measures. Major area source categories include fuel consumption, solid waste incineration, process losses (e.g., evaporation of VOC), and miscellaneous emission sources such as fires and windblown dust. Emissions from miscellaneous sources can predominate in many locations. See Reference 6 for a more detailed discussion of preparing the area source inventory.

The area source inventory can be conducted at three levels as well. The normal inventory levels include the AQCR, county, and grid level. The AQCRs are areas determined by the Federal government for air pollution planning purposes, while the county is defined by jurisdictional boundaries and the grid level by a coordinate system for modeling usage. An area source inventory will require the use of apportioning techniques to allocate emissions from the area for which data are available to the AQCR, county and grids.

Area source emissions data compiled at the county (or county equivalent) level will provide sufficient spatial resolution for some uses of the inventory. County limits are logical boundaries for compiling an emission data base for two reasons. The first is due to the areawide nature of some pollutant problems; e.g., photochemical oxidants are generally not a localized problem, but rather, form after several hours, or in some cases, days as a result of reactions among precursor pollutants emitted over broad geographical areas. Consequently, less spatial resolution is generally required for volatile organic compound (VOC) emissions than is necessary for the other pollutants for which national air quality standards exist. The second reason for compiling emission inventories on a county basis is related to data availability. The county represents the smallest basic jurisdiction unit for which various records are kept that are appropriate for use in developing area source emission estimates. Thus, because it provides sufficient resolution for the less data-intensive source/receptor relationships, and because of the convenience it affords the agency, the county is the optimum jurisdictional unit for compiling inventories that will be used for such tasks as developing an oxidant control strategy.[1] Apportionment of pollutant emissions from counties to grids, however, may be required for the dispersion modeling of pollutants other than VOCs to help in identifying local problems and developing solutions to those problems.

4.2.1 AIR QUALITY CONTROL REGION LEVEL

The Clean Air Act and its amendments directed the Federal government to designate AQCRs for high pollution urban areas. At present, there are 247 Air Quality Control Regions in the United States and its territories. Within the 50 states, the boundaries of the AQCRs tend to coincide with those of counties or states. However, many AQCRs are both interstate and intrastate, depending on the activity and geography of the area. Portions of as many as four states may be included under the limits of one AQCR. The boundaries for the AQCRs can be found in Title 40 of the Code of Federal Regulations.

The data required for an inventory on the AQCR level may be aggregated from summary statistical data of the counties. The estimation of pollutant emissions is based on the use of correlative factors such as total fuel usage, number of residential units, or other aggregate information for the counties within the AQCR. When the AQCR encompasses only a section of a county, the data concerning that area will have to be apportioned from the county total. Distribution functions based on population, dwelling units, number of commercial installations, or other common factors are used to estimate the fraction of county activity apportioned to the AQCR.

In some cases, an emission inventory for pollutants may need to extend beyond the jurisdiction of an agency. For example, a metropolitan area will often encompass a number of counties and may overlap into several states, as in interstate AQCRs. In these instances the inventory efforts of all of the agencies should be coordinated so that the results will be interchangeable and useful to all groups involved.

4.2.2 COUNTY LEVEL

Sources of information at the county level, may be provided by EPA documents, by local and regional studies dealing with city, county, or statewide categories, and statistical data from various Federal, state, or local agencies. The necessary data are usually available on a countywide basis and provide an excellent foundation for an inventory. Statistical data for census tracts can be combined to calculate values for county level usage.

As at the AQCR level, emissions can be estimated by applying emission factors to indicators of source category activity levels. These indicators will vary for each source category. For example, stationary source fuel combustion emissions can be estimated from fuel-use reports for user categories and incineration emissions can be estimated from population data.

4.2.3 GRID LEVEL

In certain instances for the purpose of dispersion modeling of area sources, much finer geographical resolution will be required than that available at the county level. The UTM coordinate system is commonly used to impose uniform grid zones onto geographic areas to allow for convenient apportioning of county activity level and emission data to grid levels. Again, the apportioning of the data is performed using distribution functions derived from population, commercial/institutional, industrial and transportation information.

4.3 MOBILE SOURCES

Mobile sources such as vehicles, aircraft, and railroads, are a significant source of emissions (see Table 1-1). They constitute an important segment of the area source category and, as is the case in this emission inventory series, are often considered as a separate category distinct from area sources. However, in presenting methods for inventorying mobile source emissions in Volume IV,[7] and consistent with the methods discussed in AP-42, only those emissions resulting from the combustion of the fuel used to power the mobile sources and certain evaporative losses have been classified as mobile source emissions. Fugitive emission resulting for example, from the re-entrainment of dust by vehicle travel over unpaved roads or the use by aircraft of dirt airstrips, are treated as area source emissions in Volume III.[6]

The emissions from motor vehicles are usually calculated from total vehicle miles traveled (VMT). VMT data are obtained from traffic studies conducted by local or state transportation agencies. A VMT breakdown by vehicle type, fuel, speed and other factor is used to account for the effect of vehicle operation on emission rates.

If measured VMT data are not available, the VMT for an area can be estimated by one of several possible techniques. Gasoline sales, for example, can be used to compute VMT through the use of average factors for the number of miles per gallon. State gasoline sales tax data or published gasoline sales data are sources of information for the determination of fuel distributed. Fuel sales can also be used to estimate off-highway source activities by agricultural equipment, industrial and construction equipment, or smaller gasoline-powered machinery and motor vehicles. However, fuel sales data are not useful for other off-highway sources. Vessels and railroads powered by several types of fuels, for example, do not necessarily use fuel in the area of purchase and correlation factors other than sales must be used to apportion emissions. Aircraft emissions are inventoried by the relating number of landing-takeoff (LTO) cycles performed at an airport to emissions.

4.3.1 AIR QUALITY CONTROL REGION AND COUNTY LEVELS

The mobile source, which is one category of area sources, is inventoried at the AQCR and county levels by using procedures similar to those discussed for area sources. Where available, state and county traffic counts, transportation studies, and national statistics are used with proper distribution functions to determine the VMT within an area. Because an AQCR tends to encompass several counties, basic data are obtained from local and county agencies and aggregated to the AQCR level.

Aircraft activity is determined by LTO data for passenger, freight, or military flights obtained from airport, county, or FAA studies. Emission factors are used to compute the quantity of pollutants released by LTO activities. Vessel emissions are computed by the quantity of fuel used and emission factors for both port and underway activity.[7]

4.3.2 GRID LEVEL

Distribution functions based on various transportation factors are used to apportion mobile sources to grid area for dispersion modeling. The apportioning factors used to allocate VMT and fuel consumption to the proper grids can be based on population, vehicular activity, the number of fuel suppliers, or other considerations. However, not all transportation emission sources can be allocated accurately using the above apportioning factors. Traffic volume counts are the most direct and accurate data for apportioning motor vehicle activity. VMT information, if available, may also be updated from fuel-use information within the region. Airport emissions are assigned to the grid that contains the airport. Railroad activities produce emissions from both rail lines and railyards, and vessels produce emissions both in port and in transit. Methods have been devised for allocation of these emissions.

4.4 TEMPORAL RESOLUTION

Annual emissions data have been gathered in most inventory efforts. However, for certain agency programs, greater temporal resolution in the form of seasonal, daily, or hourly emission data are required (hourly emission estimates are needed for several photochemical atmospheric simulation models). Definite seasonal and diurnal variations in emissions exist for certain source category/pollutant combinations due to changes in both emission factors and activity levels. For example, in addition to an increase in gasoline consumption during the summer months, evaporative organic emissions from automobiles and gasoline handling and storage operations (both major contributors of organic emissions in urban areas) will increase significantly at higher summertime temperatures. Other sources (e.g., exterior surface coating), will also produce higher oxidant season emissions. Conversely, some sources will exhibit less activity and, hence, lower emissions during the summer months. Hourly variations are also significant for many sources; e.g., mobile sources, space heating, asphalt paving, and pesticide applications.[1]

The annual emission inventory can be adjusted to reflect conditions that exist during the time period of interest. The basic provision for adjusting the inventory includes identifying those variables that influence emissions and substituting appropriate values that reflect conditions during that time period. As noted, two of the major variables are source activity and changes in emission factors due to temperature. Changes in wind speed or the seasonal modification of a product (e.g., use of gasoline with a lower vapor pressure in summer months) can also affect emission rates.[1]

The temporal resolution of emissions can be determined by contact with a source or by the use of technically rational temporal apportioning methods developed for the categories subject to significant temporal variation in emissions. Appropriate temporal adjustment is not usually afforded simply by apportioning annual emission rates into shorter time intervals. Summertime emission rates for many sources cannot normally be estimated accurately by simply dividing annual emissions by four and special adjustment techniques are desirable. A time-dependent inventory was used by EPA for the Regional Air Pollution Study (RAPS) in St. Louis, Missouri.[8] Adjustment techniques, as specified in the RAPS study, are dependent on the specific source category/pollutant combinations under consideration. The agency should become familiar with these techniques and other technical developments for determining emissions as a function of time.

References for Chapter 4.0

1. Procedures for the Preparation of Emission Inventories for Volatile Organic Compounds, Volume I, Second Edition, EPA-450/2-77-028, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1980.

2. Procedures for Emission Inventory Preparation - Volume II: Point Sources, EPA-450/4-81-026b, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1981.

3. Standard Industrial Classification Manual, Office of Management and Budget, Washington, DC, 1972.

4. AEROS Manual Series, Volume I, AEROS Overview, EPA-450/2-76-001, U.S. Environmental Protection Agency, Research Triangle Park, NC, February 1976.

5. AEROS Manual Series, Volume II, AEROS User's Manual, EPA-450/2-76-029, U.S. Environmental Protection Agency, Research Triangle Park, NC, December 1976.

6. Procedures for Emission Inventory Preparation - Volume III: Area Sources, EPA-450/4-81-026c, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1981.

7. Procedures for Emission Inventory Preparation - Volum IV: Mobile Sources, EPA-450/4-81-026d, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1981.

8. Regional Air Pollution Study. Emission Inventory Summarization, EPA-600/4-79-004, U.S. Environmental Protection Agency, Research Triangle Park, NC, January 1979.

5.0 EMISSION INVENTORY DATA COLLECTION

The major steps in the process of establishing the inventory data base involve:

Establishing a list of point, area and mobile emission sources,

Contacting each point source to obtain quantitative process and emission data,

Collecting activity level data for area and mobile sources, and using this data to develop emission estimates,

Analyzing data to determine if all necessary data are available and technically satisfactory,

Filling in any data gaps that exist in the emission data base by recontacting point sources or contact with new sources of activity level or emission data,

Processing the data (including establishing source pollutant emission rates) for use in automated data processing equipment,

Editing and validating the processed data, and

Providing for periodic inventory maintenance and updates.

Because the data needs for each inventory effort will vary, there is no one "best" way to effectively collect all needed emission inventory data. Data collection methods for an urban hydrocarbon inventory involving hundreds or thousands of sources, for example, will be different than that for a local inventory of vinyl chloride manufacturers.

5.1 INFORMATION SOURCES

In order to ensure that all emission sources are included in the emission inventory, a systematic approach must be used for obtaining this information. Traditional sources of point, area, or mobile source data should be used initially to draw up source lists. These sources include:

Point Sources

State Departments of Commerce and Labor

State Permit/Registration Files

State and Local Industrial Directories

State and Local Tax Offices

Dun and Bradstreet, Industrial Directory

Standard and Poors, Register of Corporations

Thomas Register

Local Directory of Manufacturers

Regional Planning Commissions

Trade and Professional Societies

Area Sources

State Agencies

Regional Planning Commissions

Annual Housing Survey--Bureau of the Census

Statistical Abstract of the United States--Bureau of the Census

Mineral Yearbook--Bureau of Mines

Census of Agriculture--Bureau of Census

Census of Retail Trade, Area statistics--Bureau of the Census

Energy Data Reports--Department of Energy

FAA Air Traffic Activity

Other Statistical Government Publications

Mobile Source

Highway Statistics--Federal Highway Administration

Vehicle Mile Traveled Data--State Department of Transportation

Regional Planning Commissions

The value of each of these sources, many of which are statistically compiled for states and counties, are discussed in other volumes of this Series.[1,2,3] Collectively, these references will provide much of the basic data for compilation of source and emission data, particularly for area and mobile sources, within the inventory file.

5.2 DATA COLLECTION

For a point source, the name and address and the telephone number of responsible plant personnel should be obtained for each facility when establishing a comprehensive listing of sources. This information should be provided by the facility when it completes and returns an emission inventory questionnaire to the agency or completes facility permit applications. For inventory efforts that involve a limited number of sources, a telephone call or visit to each facility can be made.

In the case of area and mobile sources the agency is not required to contact emitting sources. Emissions are calculated using activity levels (e.g., fuel consumed by the residential sector, vehicle miles traveled, and aircraft landing and takeoffs) and emission factors developed for specific source categories, travel modes, etc. Activity levels are obtained from statistical sources of information: normally, federal and state agencies; suppliers of fuel or other activity-related process feedstocks, (e.g., dry cleaning or degreasing solvents and retail paints); and state and local agencies engaged in activities such as transportation, land use planning and energy.

5.2.1 QUESTIONNAIRES

The preferred method to obtain emission-related data from large numbers of sources is the questionnaire. Questionnaires can take many forms, from the one page sheet directed at a specific industry (i.e., service stations) to a multipage effort mailed to large, complex manufacturing plants. A great deal of effort has been devoted to the development of a questionnaire that satisfies all data needs, and that can be accurately filled out by industry. A standard questionnaire, the Air Pollutant Emission Report, has been developed by EPA in response to this need (EPA Form 3520-4A (9-78)) and is included as an appendix to Volume II of this Series.[1] Agencies planning to develop their own questionnaire should consult an EPA publication entitled "Development of Questionnaires for Various Emission Inventory Uses".[4]

The emission inventory questionnaire has three basic elements: the cover letter, the instructions, and the questionnaire itself. To ensure that the questionnaire receives the prompt attention that it deserves, the cover letter should include the following:[5]

Identification of the regulatory requirements which necessitate completion of the questionnaire by the facility and the penalties incurred by noncompliance

A statement of the purpose of the questionnaire

Provisions for confidentiality, if applicable

A date for return of the completed questionnaire

The name (and telephone number) of a person within the agency to contact for assistance in completing the questionnaire

Figure 5-1 presents a typical format for a cover letter. Although a key element in the cover letter is the statement concerning the applicable regulations and potential penalities for failure to respond, the agency should foster cooperation rather than emphasizing penalties for noncompliance.

Questionnaire instructions should be comprehensive enough to adequately explain how to answer the questions. If the questionnaire is a general one designed to be applicable to all industries, the instruction sheet should delineate which sections or pages should be completed for specific processes or facilities. Figure 5-2 presents a typical general instruction sheet. If the responses to questions are designed for direct coding to computer input, the instructions should explain how to enter numbers properly. An instruction sheet that explains how the process flow schematic is to be presented must also be included.

The questionnaire itself will contain two sections, a general information section and a process details section. The general information section identifies and locates the facility and solicits emission and activity level data for the facility as a whole. The process details section covers the specific operations at the facility and solicits information on equipment, activity levels, and emission points for each process. The following information is typically requested (or is to be verified) in the general information sections.

Facility name, location and mailing address

Facility plot plan showing location and identification of emission points

Other identifying information, including facility operating schedules, number of employees, SIC code and plant UTM coordinates

Person designated as plant contact for air quality-related questions

Confidentiality, if desired, and a detailed justification of the reasons why specific information should be so classified

Whenever possible, all known information should be filled in by the agency before the questionnaire is mailed. This serves to minimize the time required by the facility to complete and return the questionnaire. The facility is directed to correct any errors in the information entered by the agency.

The process details section solicits information needed for the characterization of emissions from all sources within the facility. The line of questioning here should proceed from information that is generally known by the facility, that is, from the identification of emission processes and equipment, to the more obscure data on specific pollutant emission rates. This section usually requests some or all of the following information:

(OFFICIAL STATIONARY HEADING)

LAWS OF THIS STATE REQUIRE THAT THE INFORMATION REQUESTED BELOW
BE SUBMITTED AS SPECIFIED TO THE (AGENCY).
FAILURE TO RESPOND COULD RESULT IN
(LOCALLY APPLICABLE REGULATIONS OR PENALTIES)

Gentlemen:

The (agency) is conducting an inventory of atmospheric emissions of organic compounds from stationary sources in (area). The results will be used in the formulation of control plans as required by (applicable regulations). You are requested to provide information necessary for the assessment of emissions from equipment and processes in your plant by completing the enclosed questionnaire.

Please mark clearly any information, other than emissions data, which you consider confidential and include your reasons for doing so in your cover letter. In accordance with (state statutes) your claim for confidentiality will be evaluated and you will be notified of the decision regarding the validity of your claim. In the event of a decision not to grant confidentiality, you will have the right to appeal in accordance with (state statutes).

This questionnaire has been designed specifically for your industry; therefore, you should answer each question. If the space provided is not adequate, feel free to either copy the form, request an additional copy, or use a separate sheet.

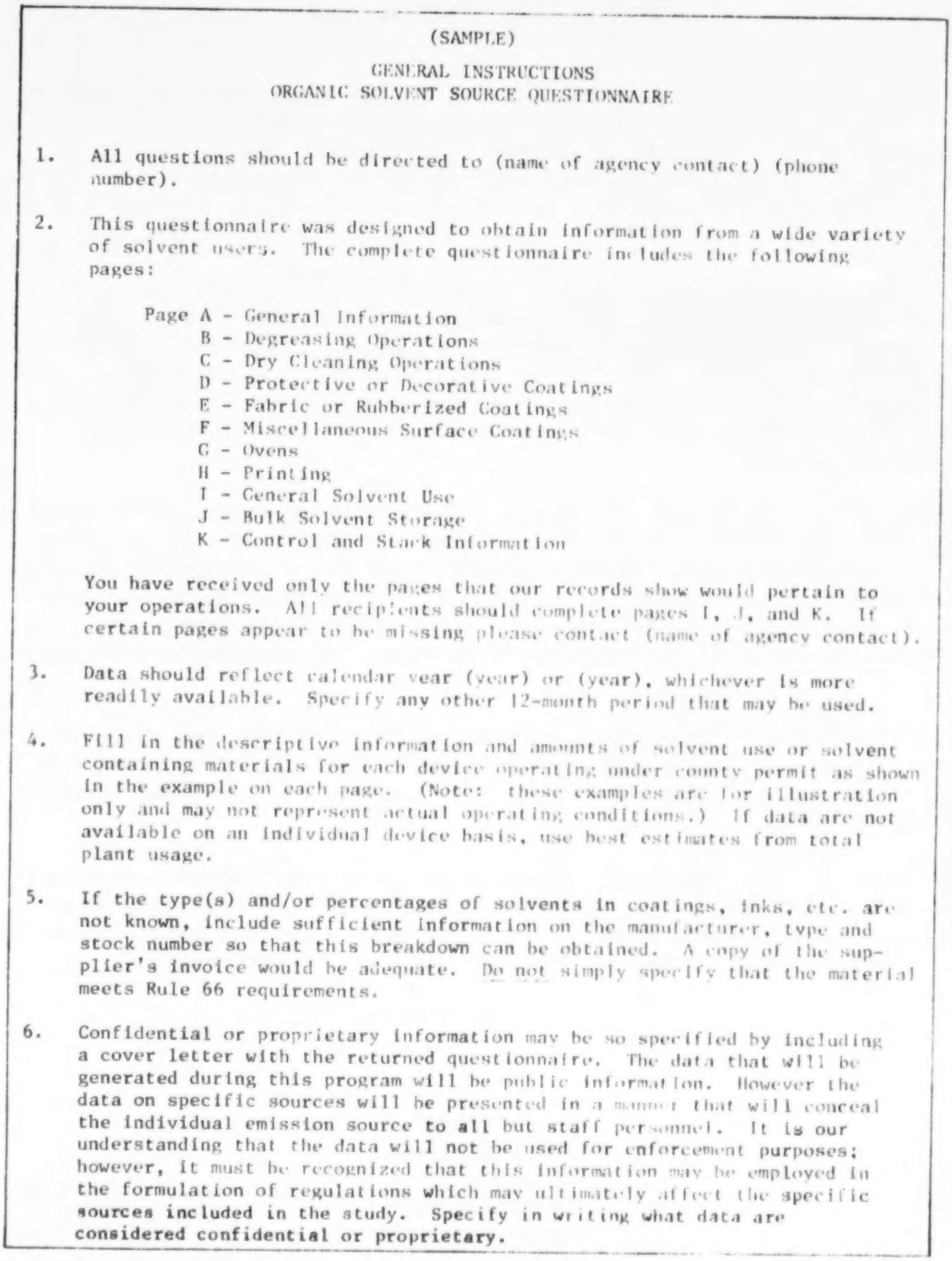
The required data should be submitted no later than (date). A return envelope is included for your convenience. Any questions regarding this questionnaire should be forwarded to (name of Agency personnel) at (phone number). Your cooperation and prompt response will be appreciated.

Sincerely,

(Name)
(Title)

Figure 5-1. Sample format for a questionnaire cover letter.

Reproduced from best available copy.



(SAMPLE)

GENERAL INSTRUCTIONS
ORGANIC SOLVENT SOURCE QUESTIONNAIRE

1. All questions should be directed to (name of agency contact) (phone number).

2. This questionnaire was designed to obtain information from a wide variety of solvent users. The complete questionnaire includes the following pages:

   Page A - General Information
   B - Degreasing Operations
   C - Dry Cleaning Operations
   D - Protective or Decorative Coatings
   E - Fabric or Rubberized Coatings
   F - Miscellaneous Surface Coatings
   G - Ovens
   H - Printing
   I - General Solvent Use
   J - Bulk Solvent Storage
   K - Control and Stack Information

   You have received only the pages that our records show would pertain to your operations. All recipients should complete pages I, J, and K. If certain pages appear to be missing please contact (name of agency contact).

3. Data should reflect calendar year (year) or (year), whichever is more readily available. Specify any other 12-month period that may be used.

4. Fill in the descriptive information and amounts of solvent use or solvent containing materials for each device operating under county permit as shown in the example on each page. (Note: these examples are for illustration only and may not represent actual operating conditions.) If data are not available on an individual device basis, use best estimates from total plant usage.

5. If the type(s) and/or percentages of solvents in coatings, inks, etc. are not known, include sufficient information on the manufacturer, type and stock number so that this breakdown can be obtained. A copy of the supplier's invoice would be adequate. Do not simply specify that the material meets Rule 66 requirements.

6. Confidential or proprietary information may be so specified by including a cover letter with the returned questionnaire. The data that will be generated during this program will be public information. However the data on specific sources will be presented in a manner that will conceal the individual emission source to all but staff personnel. It is our understanding that the data will not be used for enforcement purposes; however, it must be recognized that this information may be employed in the formulation of regulations which may ultimately affect the specific sources included in the study. Specify in writing what data are considered confidential or proprietary.

Figure 5-2. Sample of questionnaire general instruction sheet.

Process flow diagrams with equipment descriptions

Activity levels for sources of emissions

Operating schedule of process/equipment contributing to emissions

Control system descriptions

Efficiency of control systems

Stack data

Emission rates from stacks, vents, and fugitive sources

Stack emission test results and test conditions

Physical and chemical characteristics of emissions

Some general rules for formulating questionnaires are:

1. Ask the right questions--those which solicits information that the agency needs to estimate emissions from the facility;
2. Be brief--questions that are short and to the point are easier to understand and will encourage facility response; and
3. Use multiple choice questions or check boxes when possible--they also facilitate response and are especially useful if the questionnaire is formatted for computer input.

Because some facilities will need special help with the preparation of questionnaires, the agency must plan to provide such assistance. In addition, to develop a comprehensive emission data base, an organized follow-up program should be conducted by the agency to ensure return of all questionnaires.

The returned questionnaire is a part of the documentation or the emission inventory. It is retained on file as documentation along with records of all followup recontact information.

5.2.2 FILLING DATA GAPS

Returned questionnaires, facility interview reports or statistical data for determining area and mobile source activity levels and emissions must be thoroughly reviewed by agency personnel. This review will include checking the questionnaire for missing or questionable information, follow-up contact to obtain unreported information or to clarify questionable responses, and an in-depth technical analysis of the collected data to ensure its validity. The most direct and productive method of filling point source data gaps is with a follow-up phone call. This personal contact is especially effective if the data gaps are not extensive in scope. Otherwise, a second mailing to all delinquent questionnaire recipients will be required. Ideally, all incoming source data will be checked and follow-up activities conducted by agency personnel familiar with the specific industry. Questionable data due to misinterpretation, errors in transcription, or erroneous assumptions by the sources can, therefore, be quickly noted and follow-up evaluations conducted. All data received must be tabulated and/or transcribed into a format that will allow assessment of the adequacy of the data and entry into the data file. Area source data concerning activity levels and emissions must also be subjected to a quality assurance program. In addition to routine checks for transcription and calculation errors, data sources and procedures should be evaluated. Information used to estimate area source activities and emissions should be calculated, if possible, using alternative data sources.

5.3 CALCULATION OF EMISSIONS

The facility will be requested to report pollutants emitted and the emission quantities for each. The measurement method used for determining emissions should also be identified by the facility.

Emission data from the facility must be carefully assessed by agency personnel to ensure that all procedures used and process conditions maintained during the test program were consistent with the obtaining of representative data. In the absence of data on source emissions, agency personnel must use engineering judgment and knowledge of the specific process to quantify emission rates. Technical references relative to the process or similar processes can be consulted to aid in this determination. (See References 1 2, 3, and 6 for identification of some of the more useful publications relating emissions to process design and operating parameters.)

There are a number of methods currently used for establishing emission rates, which include:

1. Stack emission tests

2. Process material balances

3. AP-42 emission factors[6]

4. Other emission factors

5. Guess (educated or otherwise)

Stack tests provide the most accurate measure of process emissions, if properly conducted during a period which is generally representative of average annual operating conditions. Process material balances, in certain cases, provide a reliable measure of mass emissions. A commonly used example of this method is sulfur oxide emissions from oil-fired boilers. Since virtually all the sulfur contained in fuel oil is converted to sulfur oxide, emissions can be calculated knowing the fuel firing rate and fuel sulfur content. Similarly, in certain instances, one can estimate uncontrolled process solvent emissions if the solvent feed rate, final product solvent percentage, and process production rates are known.

In most situations where source test information is not available or material balances are not technically viable, the usual method of determining pollutant emissions for a given source type is to make generalized estimates of typical emissions from these sources using emission factors. Emission factors estimate the rate at which a pollutant is released to the atmosphere as a result of some process activity. Emission factors for each source category have been derived from emission tests, material balance calculations, and other analytical techniques applied to sources within that category. While the emissions calculated using these average values may differ from actual emissions for a specific facility, overall they provide a relatively accurate estimate of pollutant release rates for the source category under consideration. EPA's AP-42, is the most comprehensive listing of emission factors currently used.

5.4 DATA ASSESSMENT AND QUALITY ASSURANCE

In order to ensure that all source data collected for the emission inventory are accurate and have been correctly transcribed onto computer input cards (when automatic data systems are used), data validation procedures must be used. These procedures are designed to ensure that source identifier and process information, such as UTM coordinates and stack data, as well as actual source emissions levels, will be checked for errors or values that are atypical of given sources. For automated systems, this validation procedure essentially consists of two parts. An edit check is first run on all keypunched cards. This check will identify cards that are incorrectly coded or left blank without an explanation. This step helps to sort out simple clerical and keypunch errors. The source record cards are then checked to ensure that all data fall within prescribed limits set by the agency for major source categories. A typical set of these checks for boiler data is shown in Table 5-1. This validation procedure will automatically reject data points that are beyond the limits normally found for that item. Should the data as initially reported prove correct, it can easily be reinserted. Similar validation techniques are used to check emission inventory data which are compiled manually. Maximum and minimum values of certain emissions and process parameters by SCC, used by the National Emissions Data System, are available from EPA's Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711.

Typical emission inventory errors are presented in Table 5-2. This list is not exhaustive but does highlight commonly found problems. In order to minimize the quantity and impact of errors on emission inventory reliability, a quality assurance procedure should be initiated each time an inventory effort is conducted. Quality assurance/quality control techniques can be applied throughout the inventory program from planning to reporting to ensure that potential errors are minimized. These techniques can be classified as either preventive or corrective.[7] Preventive techniques are those that are applied as part of the inventory planning procedures. Some common preventive techniques, e.g., classroom instruction for personnel and the establishment of a specific emission inventory reference library, are shown in Table 5-3. Many of these techniques are already an integral part of most inventory processes. Others can be easily incorporated with few changes in normal agency procedures.

TABLE 5-1. EXAMPLE OF INTERNAL CONSISTENCY CHECKS FOR BOILERS

Type of data	Check method	Possible errors in data
1. Plant location		
A. UTM coordinates	Plot coordinates by county compare with map overlays	Plant not in correct county or wrong coordinates
B. UTM zone	Compare zone with state	Wrong zone or state
2. Stack data		
A. Flow	$9000 \le Q \le 20{,}000$ scf/MMBtu	Wrong flow or design capacity
B. Velocity	$1000 \le V \le 6{,}000$ fpm	Wrong flow or diameter
C. Height	$H \le 1000$ ft	Wrong height
D. Height to diameter ratio	$2 \le H/D \le 100$	Wrong height or diameter
3. Operating times		
A.	hr/day ≤ 24 days/week ≤ 7 weeks/year ≤ 52	Wrong hours Wrong days Wrong weeks
B. Quarterly throughput	Sum of percent annual throughput = 100	Wrong value
4. Control systems		
A. Control type	If no control, efficiency = 0	Wrong efficiency
B. Particulate type	$001 \le$ control code ≤ 018	Wrong code or different application
C. SO_2 type	$039 \le$ control code ≤ 053	Wrong code or different application
D. NO_x type	Control code = 046	Wrong code or different application
E. Control efficiency	Compatible with type of operation?	
5. Material and energy balances		
A. Design capacity	Capacity $\le 10{,}000$ MMBtu/hr	Wrong value
B. Heating value	Must be within range for fuel	Wrong value
C. Maximum firing rate	Maximum rate × H.V. = Capacity ±10 percent	Wrong maximum rate or design capacity
D. Yearly operating rate	Optimum rate $\le$ maximum rate × hours/year	Wrong optimum rate or hours
	Optimum rate $\le$ maximum rate × 8760	Wrong optimum rate
6. Emissions	Calculated = reported ±10 percent	Wrong reported value or Wrong ash or sulfur content

TABLE 5-2. ERRORS AND ERROR SOURCES IN THE EMISSION INVENTORY PROCESS

Error	Potential sources	Related procedure category
Missing facilities or sources	Permit and inventory systems out of phase; errors in estimating potential emissions; lost paperwork; problems with computer file updates.	All categories
Duplicate facilities or sources	Name changes through corporate acquisitions; use of multiple data sources with different source numbering schemes	Data collection
Missing operating or technical data or pollutants	Ambiguous data request forms; intentional deletion by facility staff; inadequate followup procedures; inadequate project control, i.e., no tentative indication of inventory size	Data collection, task planning
Erroneous technical data	Misinterpretation of data request instructions; assumed units, faulty conversions, etc.; intentional misrepresentation by the facility; poor handwriting	Data collection
Improper facility location data	Recording coordinates of facility headquarters instead of the operating facility; inability of technicians to read maps; changes in UTM zones	Data collection, technical procedures
Inconsistent area source categories or point source sizes	Failure to designate inventory cutoffs	Task planning
Inaccurate or outdated data	**Use of data without Quality Assurance or update policies**	Task planning

(continued)

TABLE 5-2 (continued)

Error	Potential sources	Related procedure category
Errors in calculations	Transcription of digits; decimal errors; entering wrong numbers on a calculator; misinterpreting emission factor applications	Technical procedures
Errors in emission estimates	Imprecise emission factors; applying the wrong emission factor; errors in throughput estimates; improper interpretation of combined sources; errors in unit conversions; faulty assumptions about control device efficiency; ranges of sulfur/ash contents in fuels	Technical procedures
Reported emissions wrong by orders of magnitude	Recording the wrong SCC code for subsequent computer emission calculations; ignoring implied decimals on computer coding sheets; transposition errors; data coding field adjustment	Data recording and reporting

TABLE 5-3. EXAMPLES OF PREVENTIVE QUALITY ASSURANCE TECHNIQUES

Procedure category	Control techniques	Problems controlled
Task planning	Training programs, certification	Misapplication of emission factors; incorrect units and codes; misinterpretation of source data
	Establish position for a quality assurance (QA) coordinator	Outdated inventory techniques; inappropriate emission factors; ineffective control techniques; overcontrol in the QA program; QA program not in phase with inventory procedures
Data collection	Edit data request forms	Burdensome forms resulting in data collection delays or noncompliance, inconsistent reporting units, etc
	Data review by local agencies	Erroneous source data reported, missing sources
	Visits to largest polluters	Missing sources, significant volume of county emissions unconfirmed
Technical procedures	List current source ID	Duplicate or missing sources
	Orientation sessions	Misunderstandings in approach or systematic errors found with corrective controls
	Develop reference materials	Unfamiliarity with processes, emission factors, codes, units, etc.
Data recording and reporting	Assign technical staff specifically for coding	Inconsistent coding, field adjustments, etc.

Corrective techniques are those that are implemented to detect errors that cannot be eliminated by preventive measures. The data validation and edit procedures previously mentioned are examples of corrective action control techniques. Some of these techniques, listed in Table 5-4, reduce random errors such as digit transposition. Another purpose, however, is to detect deficiencies in the emission inventory process. The techniques can provide useful feedback to the task planners and can provide a basis for improving the preventive control techniques. It is imperative that all errors, whether detected by techniques such as these shown in Table 5-4 or by users, source inspectors or other agency personnel, be documented in writing. Standard corrective action forms must be used and mechanisms provided to ensure that the corrective actions are instituted and effective.[7]

The appointment of one individual to act as quality assurance coordinator will help to ensure that all control techniques will be implemented once they are identified. The coordinator can independently audit the emission inventory process to ensure that errors in all phases of preparing the inventory are detected and corrected. This individual will serve as the focal point for all quality assurance problems and corrective actions. The development of an effective quality assurance program rests upon a sound assessment of system procedures and data quality, identification of potential sources of error, and the development of techniques for detecting errors as well as controlling them.

5.5 EMISSION INVENTORY MAINTENANCE AND UPDATE

The compilation of an emissions inventory is a continual process. The inventory organization must monitor and record changes in the total number of sources as well as changes in the operation of existing sources. Maintenance and updating of the inventory ensures that users are applying the most recent data and can have confidence in the information provided. In addition, recently promulgated Federal programs, such as Reasonable Further Progress requirements discussed in Chapter 3, require that inventories be upgraded annually and total emissions calculated to demonstrate progress toward meeting national ambient air quality levels.

The need for periodic inventory maintenance and update is attributable to several causes. During the period of a year, some facilities will deactivate process equipment or close completely. New facilities and processes at existing facilities will come online. Existing plants may also increase or decrease their production schedules or modify product lines and virtually all facilities must revise their fuel use and process throughput data as these figures change annually. Population and land use changes that effect area and mobile source pollutant emissions will also require inventory updating. Updated regulations and emission factors may indicate the need for further changes in the data file.

The mechanism for carrying out maintenance and update efforts vary among inventory systems. Emission inventories that are maintained manually, with only a paper record kept of all data, need only have specific data items changed. Care should be taken with these systems, however, to preserve the

TABLE 5-4. EXAMPLES OF CORRECTIVE QUALITY ASSURANCE TECHNIQUES

Procedure category	Control techniques	Problems controlled
Task planning	Annual system audits	QA procedures not cost effective, QA procedures inappropriate for updated inventory techniques
Data collection	Local agency review of completed inventory data	Missing or duplicate sources, inappropriate source controls, improperly combined sources
	Review years of record at local agency level	Inconsistent time representation among sources. Interim operating changes not reflected in permit or inventory files
Technical procedures	Engineering review of major facilities	Data or process misinterpretation
	Spot check calculations	Improper reporting units, random calculation errors, systematic calculation errors related to inadequate training or information
	Check total facility or emissions against historical inventory data	Inconsistent inventory techniques or data sources
Data recording and reporting	Edit computer data	Coding errors, e.g., improper source codes, unreasonable emissions vs. throughput, field adjustment, embedded blanks

modified or updated information for reference purposes. Computerized systems vary in the ease with which data can be modified, but are updated in essentially the same manner. The new or revised data are placed on standardized computer forms and inserted into the file. A computer program then transposes this new data onto the existing source record. If the computerized inventory system has no mechanism for storing modified or deleted information, it is recommended that tape records or a paper copy of all historical source data be maintained at the agency, again for purposes of reference.

References for Chapter 5.0

1. Procedures for Emission Inventory Preparation - Volume II: Point Sources, EPA-450/4-81-026b, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1981.

2. Procedures for Emission Inventory Preparation - Volume III: Area Sources, EPA-450/4-81-026c, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1981.

3. Procedures for Emission Inventory Preparation - Volume IV: Mobile Sources, EPA-450/4-81-026d, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1981.

4. Development of Questionnaires for Various Emission Inventory Uses, EPA-450/2-78-122, U.S. Environmental Protection Agency, Research Triangle Park, NC, March 1979.

5. Guide for Compiling a Comprehensive Emission Inventory (revised), APTD-1135, U.S. Environmental Protection Agency, Research Triangle Park, NC, December 1978.

6. Compilation of Air Pollution Emission Factors, AP-42, U.S. Environmental Protection Agency, Research Triangle Park, NC, December 1980.

7. Development of an Emission Inventory Quality Assurance Manual, EPA-450/4-79-006, U.S. Environmental Protection Agency, Research Triangle Park, NC, December 1978.

6.0 PRESENTATION OF INVENTORIES/DATA SYSTEMS

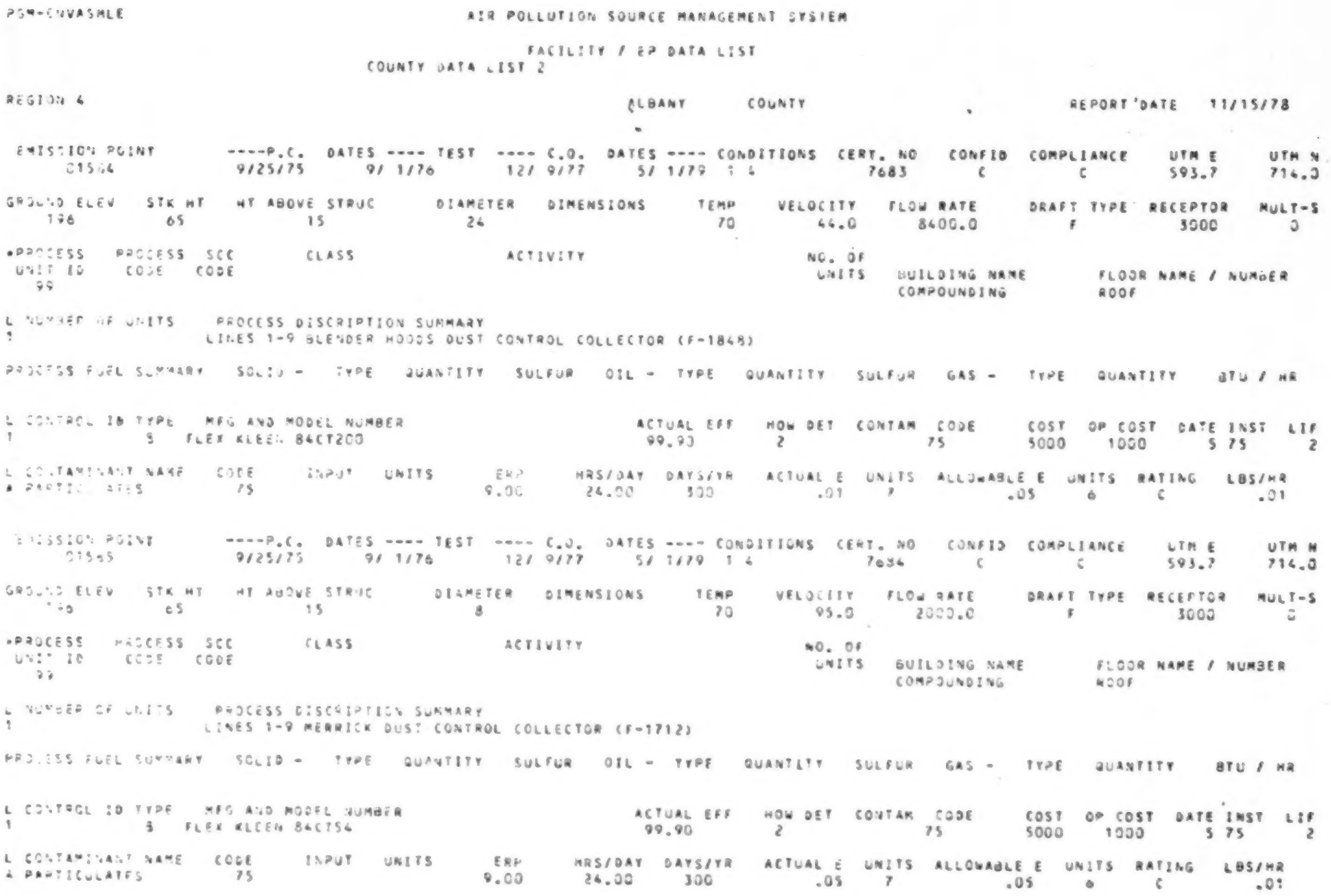
The diversity of applications for which an emission inventory can be used has resulted in a variety of methods for data presentation. Specific display methods are dependent upon many factors including the type and amount of data required, the purpose of the data summary, and the audience to which the summary is directed.

The basic "unit" of emission inventory data is the individual source record. Typical source records are presented on Figure 6-1, for the Federally-sponsored Emission Inventory System[1] (EIS) and Figure 6-2 for a computerized state inventory system (New York AIR-100). These source records contain all relevant source and emission point identifiers. Complete emission inventory reports, containing one such record for each emission point, are typically used by state and local agencies in their source-oriented activities, such as enforcement inspections and plan reviews. For other studies, source data summaries, focusing on one or more source identifiers, can be compiled. These identifiers can generally be placed into the following four categories:

1. Source Category
   - All facilities
   - Individual emission points
   - SIC (common industry)
   - SCC (common process)
   - Area sources
   - Mobile sources
   - Fugitive sources
2. Geographical Category
   - National
   - State
   - County
   - AQCR
   - AQMA
   - Other (defined for specific projects)

```
          STATE COUNTY AQCR PLANT ID
            15   2400   082   0021

  DATE      SEGMENT   CONTROL  LOCAL                                                                        PRINCIPAL
YEAR DAY      ID      REGION   CONTROL   PLANT ID    CITY UTM ZONE OWNER     CONTACT        TELEPHONE    PRODUCT
 77  000     000                                     2740    16      U   C W KERN

                                                       NUMBER OF  PROPERTY
ESTABLISHMENT NAME AND ADDRESS              ZIP    EMPLOYEES    AREA     MAILING ADDRESS                          ZIP
MICHIGAN CITY-NIPSCO                                          00000.0

  DATE    SEGMENT POINT ID                  UTM COORDINATES    LATITUDE      LONGITUDE    ANNUAL THRUPUT   NORMAL OPERATING
YEAR DAY    ID     NEDS USER  SIC  IPP HORIZONTAL VERTICAL DEG MIN SEC  DEG MIN SEC  DEC MAR JUN SEP  HR/D D/WK WK/YR
 78  000   104     04         4911 50    507.6     4618.6                             09  37  39  15   24   7    52

BOILER   SPACE  S    T    A    C    K          D    A    T    A        COMP SCHED   COMP STATUS          CONTROL REGULATION
CAPACITY HEAT   HEIGHT DIAM TEMP FLOW RATE VELOCITY PLUME PNTS  COMP YEAR MONTH  YEAR MONTH DAY  ECAP REG 1 REG 2 REG 3
 00482    00.0   0270  08.0 0325  0156000              0000                                          0048  0013  0017

NUMBER OF    POLLUTANT CONTROL    CONTROL EQUIP  ESTM CNTL          E M I S S I O N S              ESTIMATE  TEST
POLLUTANTS      ID       COST       PRI    SEC     EFFICIENCY  ESTIMATE MEASURED ALLOWABLE UNITS  METHOD   METHOD
    05          TSP                 010    000        98.0      0000020            0000188           3
                CO                  000    000        00.0      0000041            0000040           3
                SO2                 000    000        00.0      0002235            0004066           3
                NOX                 000    000        00.0      0002175            0002151           3
                HC                  000    000        00.0      0000011            0000011           3

  DATE    SEGMENT      SCC        BEC           FUEL -   MAX DESIGN  SULFUR    ASH     HEAT
YEAR DAY    ID     I II III IV NBR ID  UNITS PROCESS     RATE      CONTENT CONTENT CONTENT CONF SOURCE
 78  000 2 04 05 1 01 002 03                 0073530  0023.479     1.60     13.7   00021    2    B

                            E F     NUMBER OF  POLLUTANT EMISSION     ASH /  FACTOR
SOURCE DESCRIPTION         SOURCE  EMSN FCTR     ID       FACTOR     SULFUR  UNITS
BOILER 4                     A        05         TSP     000002.000    A
                                                 HC      000000.300
                                                 NOX     000055.000
                                                 SO2     000038.000    S
                                                 CO      000001.000

  DATE    SEGMENT      SCC        BEC           FUEL -   MAX DESIGN  SULFUR    ASH     HEAT
YEAR DAY    ID     I II III IV NBR ID  UNITS PROCESS     RATE      CONTENT CONTENT CONTENT CONF SOURCE
 77  000 2 04 10 1 01 006 01                 0000430  0000.482     0.00     00.0   01000    2    B

                            E F     NUMBER OF  POLLUTANT EMISSION     ASH /  FACTOR
SOURCE DESCRIPTION         SOURCE  EMSN FCTR     ID       FACTOR     SULFUR  UNITS
BOILER 4                     A        05         TSP     000010.000
                                                 HC      000001.000
                                                 NOX     000700.000
                                                 SO2     000000.600
                                                 CO      000017.000
```

Figure 6-1. Emission Inventory System - Source Record.



```
PSM-CNVASMLE                              AIR POLLUTION SOURCE MANAGEMENT SYSTEM

                                                  FACILITY / EP DATA LIST
                               COUNTY DATA LIST 2

REGION 4                                                     ALBANY      COUNTY                        REPORT'DATE   11/15/78

 EMISSION POINT        ----P.C.  DATES ---- TEST  ---- C.O.  DATES ---- CONDITIONS  CERT. NO   CONFID  COMPLIANCE     UTM E      UTM N
     01544             9/25/75      9/ 1/76      12/ 9/77     5/ 1/79  1 4          7683         C          C         593.7      714.0

GROUND ELEV   STK HT   HT ABOVE STRUC      DIAMETER   DIMENSIONS      TEMP    VELOCITY   FLOW RATE     DRAFT TYPE  RECEPTOR   MULT-S
    196         65          15                24                        70        44.0      8400.0           F          3000        0

*PROCESS   PROCESS  SCC        CLASS                  ACTIVITY                     NO. OF
 UNIT ID    CODE   CODE                                                             UNITS   BUILDING NAME      FLOOR NAME / NUMBER
   99                                                                                       COMPOUNDING        ROOF

L NUMBER OF UNITS    PROCESS DISCRIPTION SUMMARY
1                   LINES 1-9 BLENDER HOODS DUST CONTROL COLLECTOR (F-1848)

PROCESS FUEL SUMMARY   SOLID -   TYPE   QUANTITY   SULFUR   OIL -  TYPE   QUANTITY   SULFUR   GAS -   TYPE   QUANTITY    BTU / HR

L CONTROL ID TYPE   MFG AND MODEL NUMBER                          ACTUAL EFF   HOW DET  CONTAM  CODE      COST  OP COST  DATE INST  LIF
1           5   FLEX KLEEN 84CT200                                  99.90        2                75       5000    1000      5 75      2

L CONTAMINANT NAME    CODE      INPUT   UNITS      ERP      HRS/DAY  DAYS/YR   ACTUAL E  UNITS  ALLOWABLE E  UNITS  RATING    LBS/HR
A PARTICULATES         75                          9.00      24.00     300          .01    7            .05     6      C          .01

 EMISSION POINT        ----P.C.  DATES ---- TEST  ---- C.O.  DATES ---- CONDITIONS  CERT. NO   CONFID  COMPLIANCE     UTM E      UTM N
     01545             9/25/75      9/ 1/76      12/ 9/77     5/ 1/79  1 4          7684         C          C         593.7      714.0

GROUND ELEV   STK HT   HT ABOVE STRUC      DIAMETER   DIMENSIONS      TEMP    VELOCITY   FLOW RATE     DRAFT TYPE  RECEPTOR   MULT-S
    196         65          15                 8                        70        95.0      2000.0           F          3000        0

*PROCESS   PROCESS  SCC        CLASS                  ACTIVITY                     NO. OF
 UNIT ID    CODE   CODE                                                             UNITS   BUILDING NAME      FLOOR NAME / NUMBER
   99                                                                                       COMPOUNDING        ROOF

L NUMBER OF UNITS    PROCESS DISCRIPTION SUMMARY
1                   LINES 1-9 MERRICK DUST CONTROL COLLECTOR (F-1712)

PROCESS FUEL SUMMARY   SOLID -   TYPE   QUANTITY   SULFUR   OIL -  TYPE   QUANTITY   SULFUR   GAS -   TYPE   QUANTITY    BTU / HR

L CONTROL ID TYPE   MFG AND MODEL NUMBER                          ACTUAL EFF   HOW DET  CONTAM  CODE      COST  OP COST  DATE INST  LIF
1           5   FLEX KLEEN 84CT54                                   99.90        2                75       5000    1000      5 75      2

L CONTAMINANT NAME    CODE      INPUT   UNITS      ERP      HRS/DAY  DAYS/YR   ACTUAL E  UNITS  ALLOWABLE E  UNITS  RATING    LBS/HR
A PARTICULATES         75                          9.00      24.00     300          .05    7            .05     6      C          .01
```

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Figure 6-2. New York - AIR 100 Source Record.

3. Pollutant Category

   - Individual criteria pollutants
   - All criteria pollutants
   - Special (NESHAPS, Reactive VOC, etc.)

4. Other

   - Energy use (by fuel)
   - Control device application

Data summaries are usually compiled relating these identifiers. For example, lists may detail the major particulate-emitting facilities within an AQCR; all facilities within a state that use asbestos and have an SIC code of 3293 (gaskets, packing, and sealing devices); or all facilities that consume more than 100,000 tons of bituminous coal per year. Once the specific data requirements of a project are defined and the appropriate data summaries are obtained from an agency's emission inventory, the data must be presented in an appropriate format. The following subsection illustrates various presentation techniques. Many of the examples shown are taken from EPA reports and reflect national emissions; however, the techniques shown are useful to the reporting aspects of state and local air pollution problems.

6.1 PRESENTATION TECHNIQUES

The most common method of presenting emission inventory data is the tabulated summary. Figures 6-3 through 6-5 present examples of this display technique. A second major presentation technique is the pie chart. This method, like all graphical displays, is often useful when presenting data to those who do not have the time and/or expertise to interpret detailed tabular summaries. Figures 6-6 and 6-7 are two examples of pie charts used to present emission information. Pie charts present component data as a percentage of the whole and, therefore, are useful for representing the relative contribution of various emission source categories in a given area. Figure 6-6, for example, presents the relative contribution of each of the major pollutants to total criteria air pollutant emissions in the United States. Sulfur oxides and nitrogen oxides are singled out in this chart, as these data were used in a presentation concerning the acid rain problem. Figure 6-7 presents the relative contribution of various categories to total volatile organic compound (VOC) emissions.[4] Without describing actual emission levels, this chart identifies the major source categories (bulk petroleum storage and degreasing) and their contribution to total emissions. Pie charts simplify the comparison of emission data from various sources by concisely summarizing large amounts of information that may occupy several pages of tables in a report.

The time series of chart represents another graphical display technique, Figures 6-8 and 6-9. These charts displays changes over time of one or several components, and are often used in emission trend reports. Knowledge

Source category	TSP	SO_x	NO_x	VOC	CO
Transportation	1.1	0.8	9.2	11.5	85.7
Highway vehicles	0.8	0.4	6.7	9.9	77.2
Non-highway vehicles	0.3	0.4	2.5	1.6	8.5
Stationary fuel combustion	4.8	22.4	13.0	1.5	1.2
Electric utilities	3.4	17.6	7.1	0.1	0.3
Industrial	1.2	3.2	5.0	1.3	0.6
Residential, commercial, and institutional	0.2	1.6	0.9	0.1	0.3
Industrial processes	5.4	4.2	0.7	10.1	8.3
Chemicals	0.2	0.2	0.2	2.7	2.8
Petroleum refining	0.1	0.8	0.4	1.1	2.4
Metals	1.3	2.4	0	0.1	2.0
Mineral products	2.7	0.6	0.1	0.1	0
Oil and gas production and marketing	0	0.1	0	3.1	0
Industrial organic solvent use	0	0	0	2.7	0
Other processes	1.1	0.1	0	0.3	1.1
Solid waste	0.4	0	0.1	0.7	2.6
Miscellaneous	0.7	0	0.1	4.5	4.9
Forest wildfires and managed burning	0.5	0	0.1	0.7	4.3
Agricultural burning	0.1	0	0	0.1	0.5
Coal refuse burning	0	0	0	0	0
Structural fires	0.1	0	0	0	0.1
Miscellaneous organic solvent use	0	0	0	3.7	0
Total	12.4	27.4	23.1	28.3	102.7

Note: A zero indicates emissions of less than 50,000 metric tons per year.

Figure 6-3. Nationwide emission estimates, 1977 (10^6 metric tons/year).

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```
                                   ***NEDS ANNUAL FUEL SUMMARY REPORT***
STATE: OHIO                                                            USER FILE CREATE DATE:   FRIDAY   FEBRUARY 24, 1978

                                                                       DATE OF RUN: 07/12/78

                   ANTH COAL     BITH COAL     RESID OIL     DIST OIL      NAT GAS       WOOD/BARK     GASOLINE      DIESEL
                 ************* ************* ************* ************* ************* ************* ************* *************
                     TONS          TONS        1000 GALS     1000 GALS     10E6 CUFT       TONS        1000 GALS     1000 GALS

AREA SOURCES
  STATIONARY
     RESIDENTIAL        42360        314020                      510570        445450         47500
     INDUSTRIAL                                                                133270
     COMM-INSTL         34910                      63480          76300        168350

  MOBILE
     LIGHT VEHICLE                                                                                         4677532
     HEAVY VEHICLE                                                                                          184988        526778
     RAILROAD                                                                                                             160360
     OFF-HIGHWAY                                                                                            131740        304810
     VESSELS                         117690         8170                                                     41933         13270

     AREA TOTAL         77270        431710        71650         586870        747070         47500        5035702       1005218

POINT SOURCES
  EXT COMB
     ELEC GEN                      55142486        51268          38972        122457          2500
     INDUSTRIAL          5200       7208507       153205         115512        282027         77445
     COMM-INSTL                      707166         8706          11581          1114

  INPROCESS              9620        650702       109906          66089         37762

  INTERNL COMB
     ELEC GEN                                                     44252          1734                                      1116
     INDUSTRIAL
     COMM-INSTL

     POINT TOTAL        14820      63708861       323085         276406        445094         79945                       1116

   GRAND TOTAL          92090      64140571       394735         863276       1192164        127445        5035702       1006334

                   LIGNITE       COKE          BAGASSE       PROCESS GAS   LIQ-PETRO     JET FUEL      SOLID WASTE   LIQUID WASTE
                 ************* ************* ************* ************* ************* ************* ************* *************
                     TONS          TONS          TONS        10E6 CUFT     1000 GALS     1000 GALS       TONS        1000 GALS

POINT SOURCES
  EXT COMB
     ELEC GEN                                                      1801
     INDUSTRIAL          9500                                   2402377
     COMM-INSTL

  INPROCESS                         22240                        828423

  INTERNL COMB
     ELEC GEN
     INDUSTRIAL
     COMM-INSTL

   GRAND TOTAL           9500         22240                       3232601
```

Source: Reference 2.

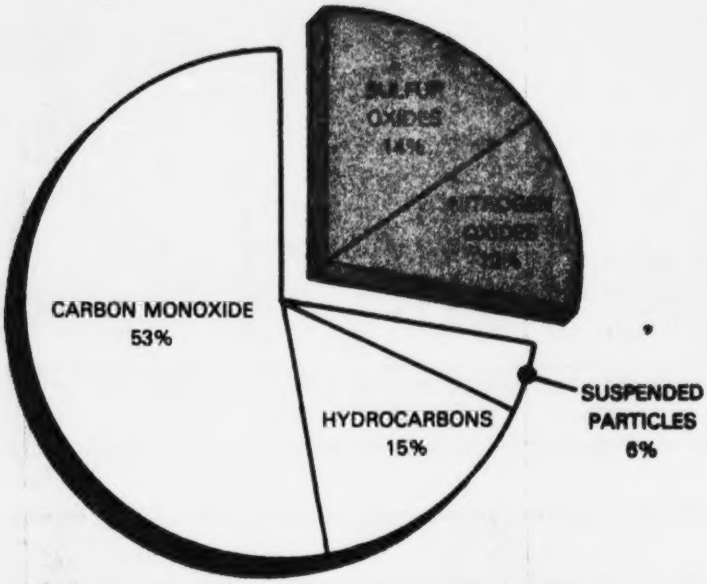
Figure 6-4. NEDS annual fuel summary report.

AQCR 215 METROPOLITAN DALLAS-FORT WORTH (TEX)

Emission categories	Pollutant, tons per year				
	Particulates	Sulfur oxides	Nitrogen oxides	Hydro-carbons	Carbon monoxide
GRAND TOTAL	195,841	116,944	240,352	382,705	1,182,330
-AREA	89,212	60,745	175,784	305,007	1,178,510
-POINT	106,629	56,199	64,569	77,698	3,821
FUEL COMBUSTION-AREA	69,945	49,932	20,079	1,253	2,317
-POINT	1,925	1,078	58,460	230	1,050
External Combustion-area	69,945	49,932	20,079	1,253	2,317
-point	1,911	1,064	53,093	173	941
Residential Fuel-area	340	20	2,679	269	671
Anthracite Coal	0	0	0	0	0
Bituminous Coal	0	0	0	0	0
Distillate Oil	6	0	8	2	3
Residual Oil	0	0	0	0	0
Natural Gas	334	20	2,671	267	668
Wood	0	0	0	0	0
Electric Generation-point	1,645	509	48,312	113	835
Anthracite Coal	0	0	0	0	0
Bituminous Coal	0	0	0	0	0
Lignite	0	0	0	0	0
Residual Oil	39	473	407	8	11
Distillate Oil	21	36	105	4	2
Natural Gas	1,585	60	47,800	101	822
Process Gas	0	0	0	0	0
Coke	0	0	0	0	0
Solid Waste/Coal	0	0	0	0	0
Other	0	0	0	0	0
Industrial Fuel-area	68,280	41,755	12,403	720	1,228
-point	257	475	4,746	58	104
Anthracite Coal-area	0	0	0	0	0
-point	0	0	0	0	0
Bituminous Coal-area	66,224	24,388	6,017	401	802
-point	0	0	0	0	0
Lignite-point	0	0	0	0	0
Residual Oil-area	1,322	17,368	3,448	172	230
-point	9	48	20	1	0
Distillate Oil-area	734	0	2,937	147	196
-point	32	415	105	1	1
Natural Gas-area	0	0	0	0	0
-point	165	5	4,568	31	52
Process Gas-area	0	0	0	0	0
-point	0	0	0	0	0
Coke-point	0	0	0	0	0
Wood-area	0	0	0	0	0
-point	50	8	50	25	50
Liquid Petroleum Gas-point	0	0	0	0	0
Bagasse-point	0	0	0	0	0
Other-point	1	0	2	0	0
Commercial-Institutional Fuel-area	1,324	8,157	4,997	264	418
-point	10	0	35	2	2
Anthracite Coal-area	0	0	0	0	0
-point	0	0	0	0	0
Bituminous Coal-area	0	0	0	0	0
-point	0	0	0	0	0
Lignite-point	0	0	0	0	0
Residual Oil-area	621	8,153	1,619	81	108
-point	0	0	0	0	0
Distillate Oil-area	633	0	2,333	127	169
-point	3	0	6	0	0
Natural Gas-area	70	4	845	56	141
-point	7	0	28	2	2
Wood-area	0	0	0	0	0
-point	0	0	0	0	0
Liquid Petroleum Gas-point	0	0	0	0	0
Miscellaneous-point	0	0	0	0	0
Internal Combustion-point	14	14	5,367	58	109
Electric Generation	0	0	13	0	2
Distillate Oil	0	0	7	0	1
Natural Gas	0	0	7	0	1
Diesel Fuel	0	0	0	0	0
Industrial Fuel	0	0	5,331	0	0
Distillate Oil	0	0	0	0	0
Natural Gas	0	0	5,331	0	0
Gasoline	0	0	0	0	0
Diesel Fuel	0	0	0	0	0
Other	0	0	0	0	0
Commercial-Institutional	0	0	0	0	0
Diesel Fuel	0	0	0	0	0
Other	0	0	0	0	0
Engine-Testing	14	14	23	58	107
Aircraft	12	13	14	46	32
Other	2	1	9	12	75
Miscellaneous	0	0	0	0	0
INDUSTRIAL PROCESS-POINT	104,470	55,096	6,065	77,238	2,133
Chemical Manufacturing	679	2,694	1,118	3,238	0
Food/Agriculture	4,678	0	0	0	0
Primary Metal	210	477	41	3	1,578
Secondary Metals	339	8,543	6	48	487
Mineral Products	98,014	41,146	2,095	361	27
Petroleum Industry	210	1,080	2,560	257	38
Wood Products	137	0	0	210	0
Evaporation	8	0	3	68,692	0
Metal Fabrication	2	0	0	276	0
Leather Products	0	0	0	0	0
Textile Manufacturing	2	0	0	52	0
Inprocess Fuel	189	1,157	242	2	4
Other/Not Classified	2	0	0	4,199	0
SOLID WASTE DISPOSAL-AREA	2,927	254	874	5,590	16,007
-POINT	233	26	64	230	637
Government-point	146	0	17	172	516
Municipal Incineration	0	0	0	0	0
Open Burning	146	0	17	172	516
Other	0	0	0	0	0
Residential-area	2,220	108	609	4,773	13,827
On Site Incineration	651	10	20	1,831	5,493
Open Burning	1,569	98	588	2,942	8,334
Commercial-Institutional-area	384	82	144	430	1,142
-point	0	0	0	0	0
On Site Incineration-area	232	73	87	145	334
-point	0	0	0	0	0
Open Burning-area	152	9	57	285	808
-point	0	0	0	0	0
Apartment-point	0	0	0	0	0
Other-point	0	0	0	0	0
Industrial-area	323	64	121	387	1,038
-point	87	24	27	58	121
On Site Incineration-area	175	55	66	110	252
-point	87	24	27	58	121
Open Burning-area	148	9	55	278	786
-point	0	0	0	0	0
Auto Body Incineration-point	0	0	0	0	0
Other-point	0	0	0	0	0
Miscellaneous-point	0	0	0	0	0
TRANSPORTATION-AREA	16,340	10,599	154,831	188,132	1,160,186
Land Vehicles	15,564	10,202	152,191	162,057	1,143,254
Gasoline	10,244	2,931	88,411	151,373	1,112,294
Light Vehicles	9,591	2,685	81,403	135,707	969,361
Heavy Vehicles	495	163	5,214	10,606	85,566
Off Highway	157	82	1,795	5,060	57,367
Diesel Fuel	5,320	7,271	63,780	10,684	30,960
Heavy Vehicles	1,369	1,742	14,653	2,227	15,634
Off Highway	2,512	2,248	27,834	3,047	7,845
Rail	1,439	3,280	21,293	5,410	7,481
Aircraft	777	348	2,600	4,808	12,596
Military	397	76	191	924	992
Civil	222	44	201	983	5,619
Commercial	158	228	2,209	2,901	5,986
Vessels	0	9	40	1,363	4,335
Bituminous Coal	0	0	0	0	0
Diesel Fuel	0	0	0	0	0
Residual Oil	0	0	0	0	0
Gasoline	0	9	40	1,363	4,335
Gas Handling Evaporation Loss	0	0	0	19,903	0
MISCELLANEOUS-AREA	0	0	0	110,032	0
Forest Fires	0	0	0	0	0
Structural Fires	0	0	0	0	0
Slash Burning	0	0	0	0	0
Frost Control	0	0	0	0	0
Solvent Evaporation Loss	0	0	0	110,032	0

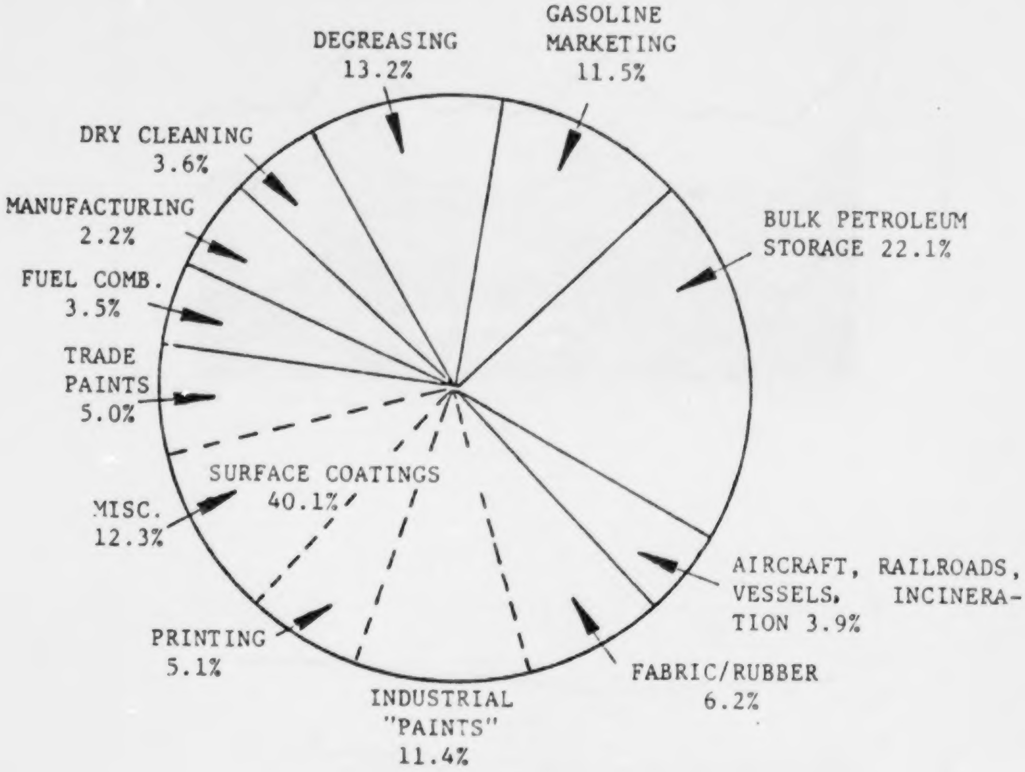
Source: Reference 3.

Figure 6-5. Air pollutant emissions in AQCR 215-Metropolitan Dallas - Fort Worth (TX).



Source: National Air Quality, Monitoring, and Emission Trends Report, 1977, US EPA, December 1978.

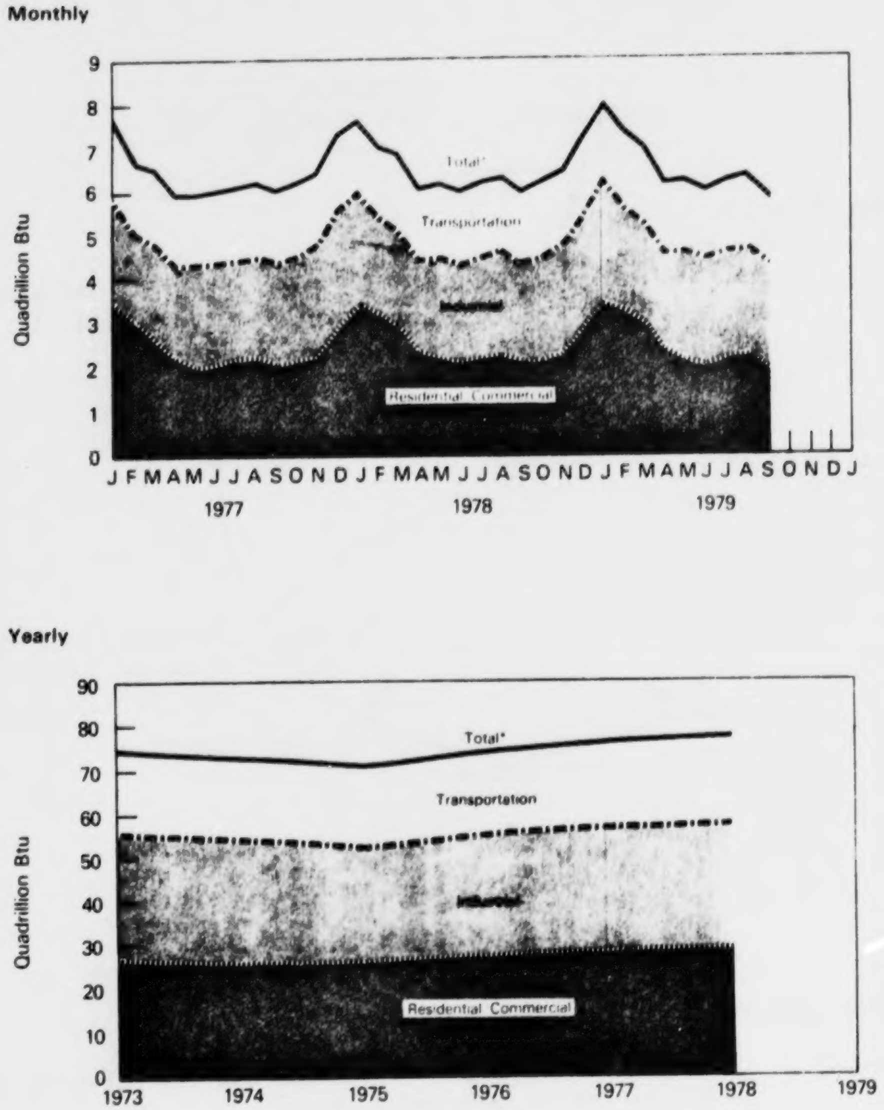
Figure 6-6. Air emissions of pollutants in the United States.



(Note: Highway vehicles are excluded)

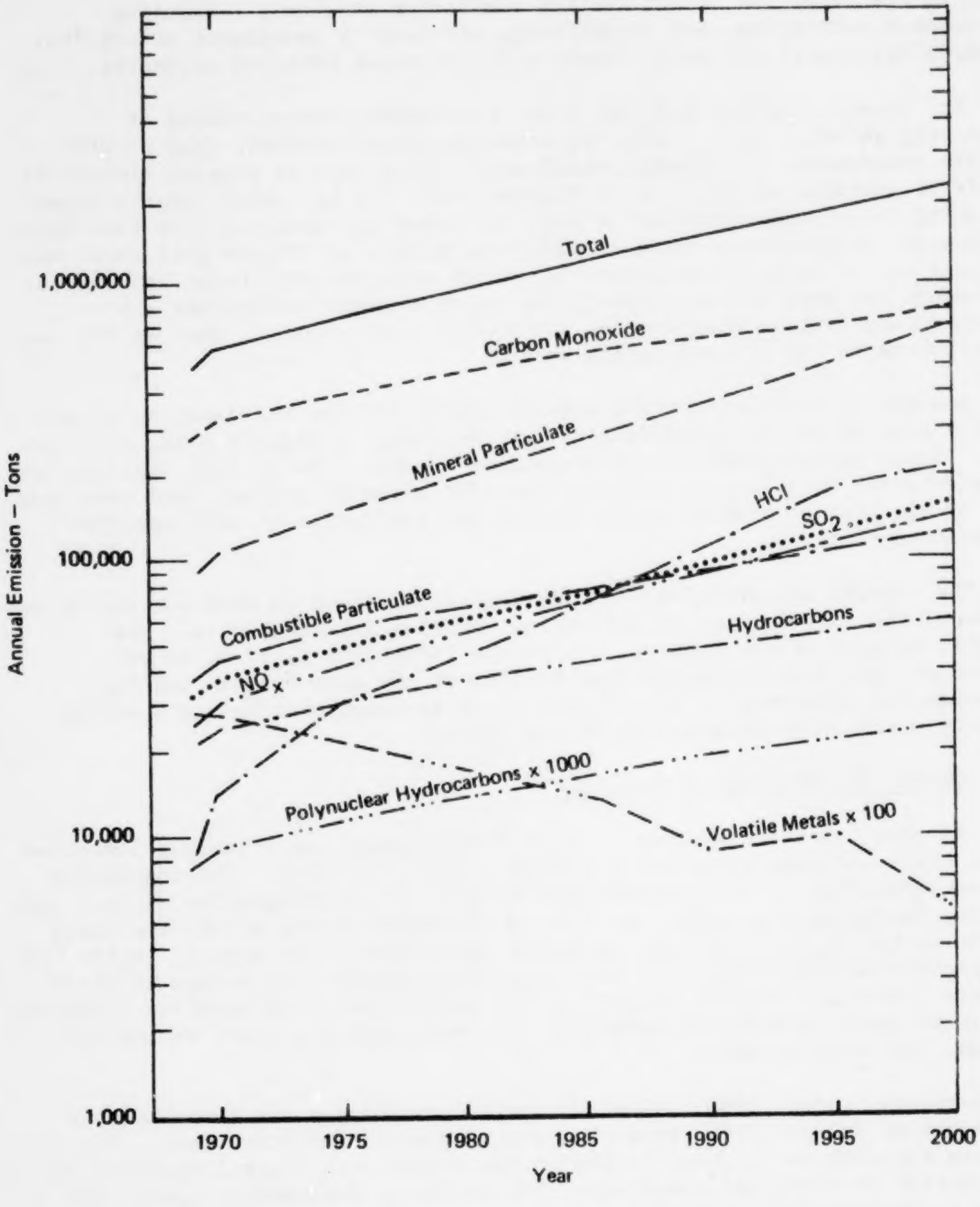
Source: Reference 4.

Figure 6-7. An example of pie chart displaying the distribution of VOC emissions in a survey area.



*Btu consumption for all sectors is cumulated to create total.

Figure 6-8. Energy consumption by economic sector.



Source: Reference 5.

Figure 6-9. Total annual emission estimates for U.S. municipal incineration systems.

of emission variations will aid regulatory personnel in such activities as planning the operation of air quality monitoring stations; scheduling enforcement activities; and establishing air quality management priorities, based on historical or, as in Figure 6-9, projected emission estimates.

Bar charts, Figures 6-10 and 6-11, are another common method of presenting emission data. Like the other graphical methods, they provide visible comparisons of emission magnitudes. When used to present historical trends of multiple sources, as in Figures 6-10, the bar chart clearly shows the trend in overall emissions as well the trend in emissions from individual components, particularly those of major contributors. Figure 6-11 shows how the same set of data can be presented in two separate ways using bar charts. The amount and type of fuel used by the major consumer categories are presented and certain dependencies are easily distinguished, such as the use of petroleum in the transportation sector.

Another graphical technique that is useful for the presentation of air quality data is the emission density map, as shown in Figures 6-12, 6-13 and 6-14. These emission density presentations identify the spatial distribution of emissions. They clearly indicate specific areas of concern, and have been used by agencies to present justification for adaptation of area specific emission regulations.

The tabular and graphical display techniques shown in this section do not represent the only methods of presenting emission inventory data. The specific purpose of the summary, the source indicators that are to be summarized, the data reporting capabilities of the data system, and the environmental awareness of the audience must be considered before specific techniques are selected and used by the agency.

6.2 SUMMARY OF INVENTORY DATA SYSTEMS

Emission inventory systems of varying complexity are presently installed at all state and most local air pollution control agencies. The complexity and sophistication of the systems used by state or local agencies reflect many factors, including the number and type of emission sources within the state and the technical and financial resources available to the agency. While EPA has specific emission inventory reporting requirements, the manner in which data are stored and handled is left to the individual state agencies. Several methods of handling emission inventory data have evolved, based on special in-house data requirements.

Currently (circa 1980), about 20 state agencies use the Comprehensive Data Handling System (CDHS) to manage their emission inventory data. The software for CDHS is provided by EPA to the state/local control agencies for installation on their own computers. The system is designed to assist the agency in meeting EPA reporting requirements and all software and updates to the system are provided by EPA's National Air Data Branch (NADB). CDHS consists of the following subsystems:

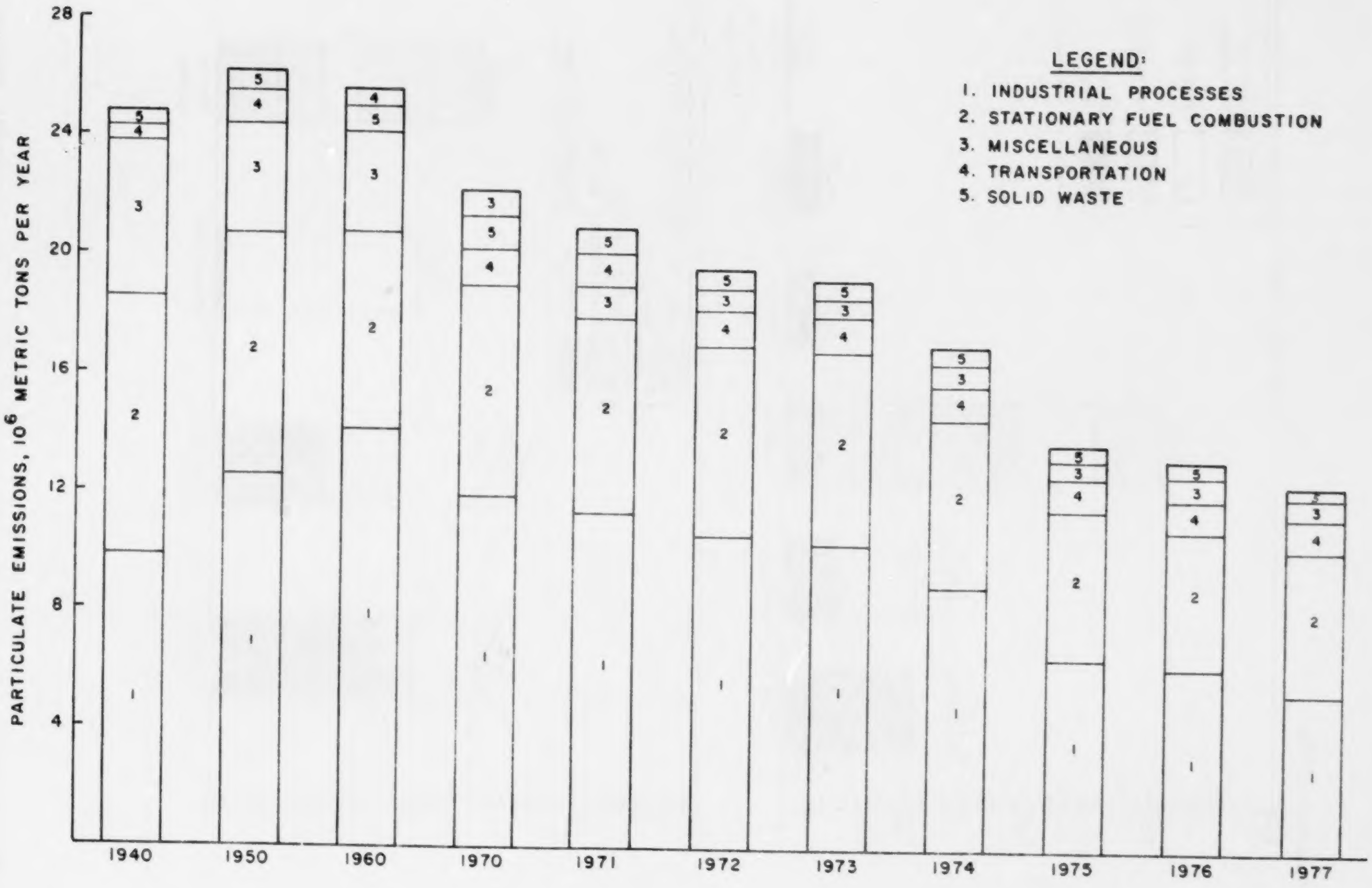


Figure 6-10. Historical particulate emissions by source category.

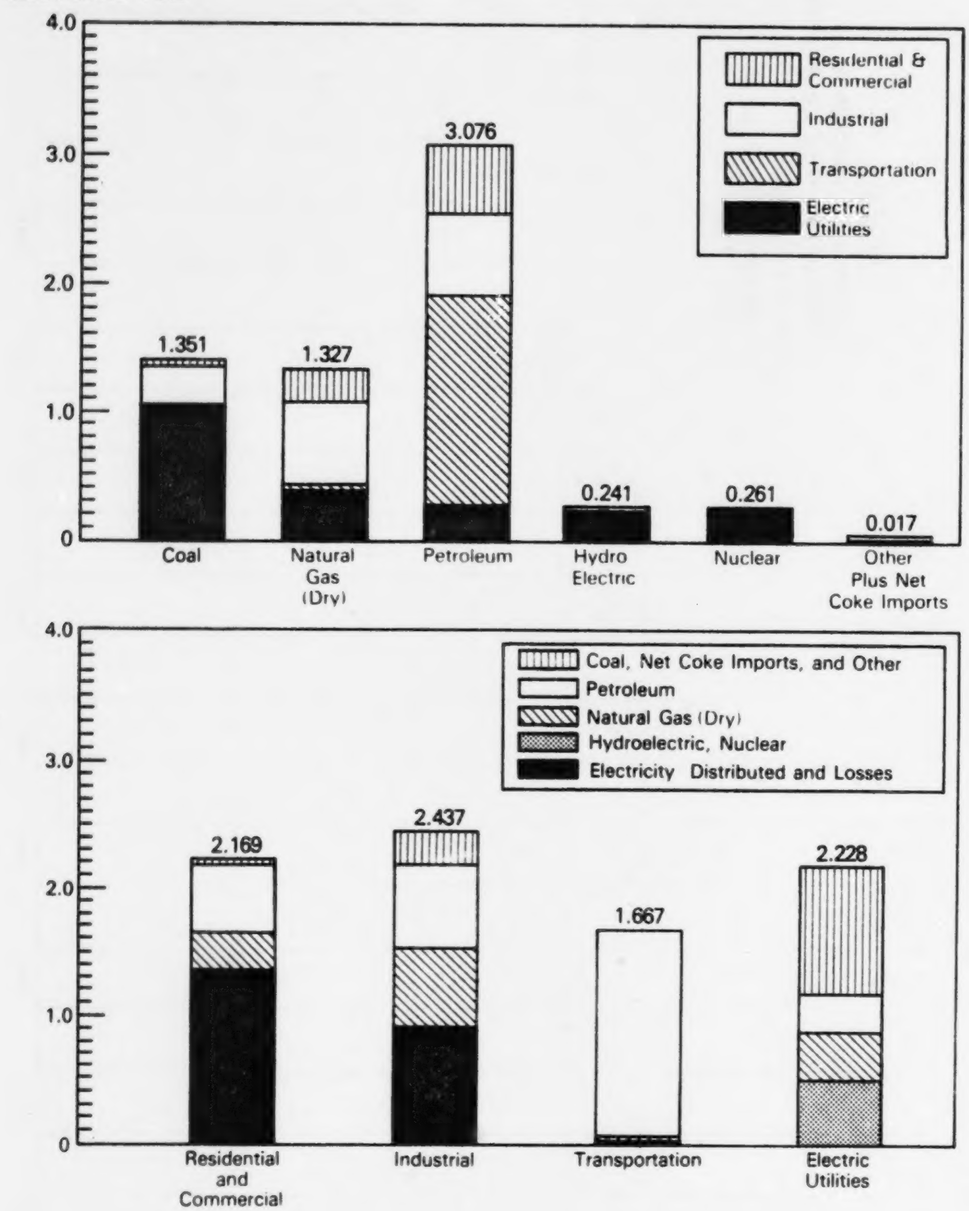


Figure 6-11. Energy consumption by fuel use and consumer category.

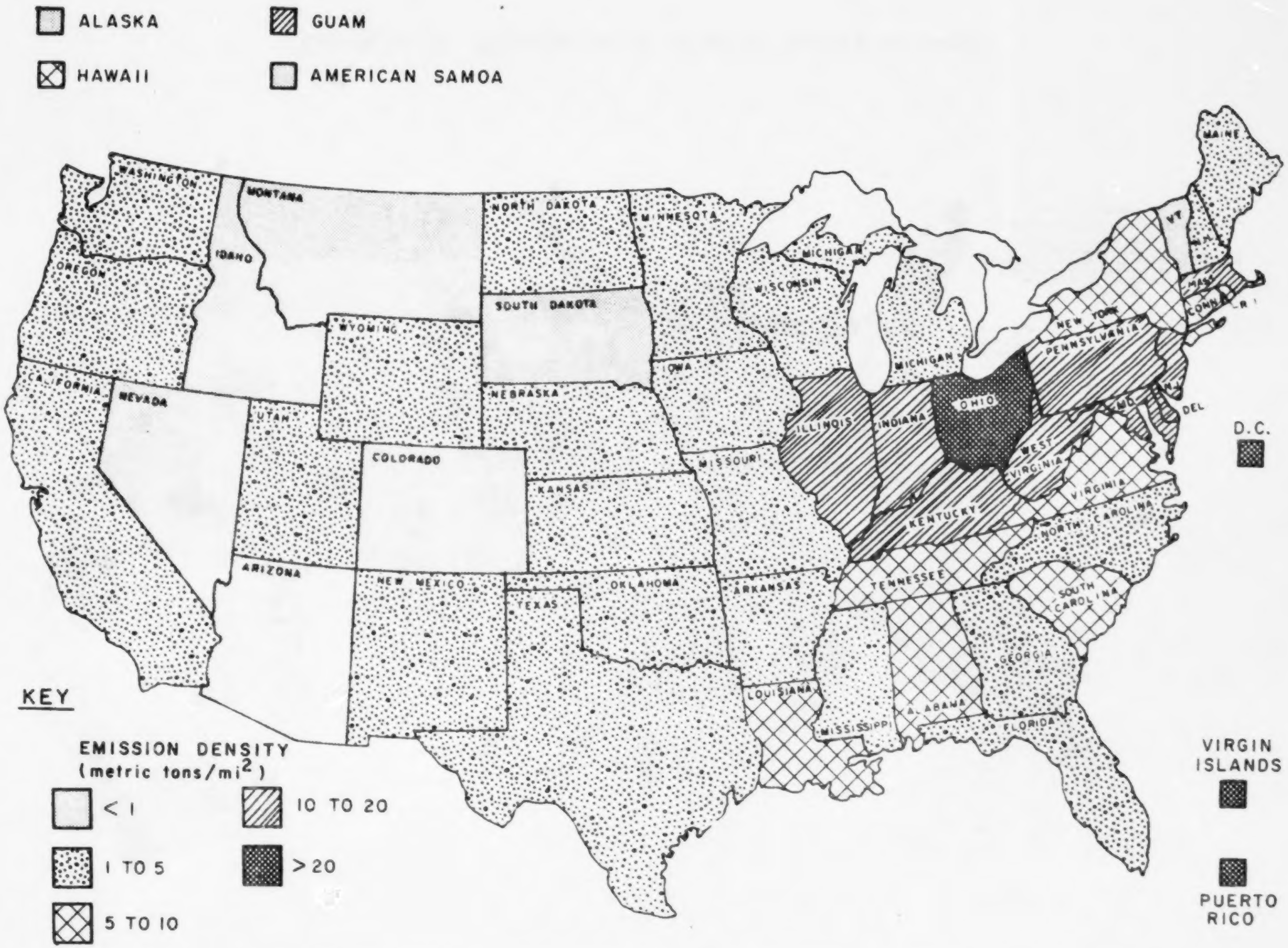

ALASKA
GUAM
HAWAII
AMERICAN SAMOA
WASHINGTON
MONTANA
NORTH DAKOTA
MINNESOTA
MICHIGAN
MAINE
VT
N.H.
OREGON
IDAHO
WISCONSIN
MASS
CONN
R.I.
SOUTH DAKOTA
WYOMING
NEW YORK
PENNSYLVANIA
IOWA
MICHIGAN
CALIFORNIA
NEVADA
NEBRASKA
UTAH
ILLINOIS
INDIANA
OHIO
N.J.
MD.
DEL
D.C.
COLORADO
KANSAS
MISSOURI
WEST VIRGINIA
VIRGINIA
KENTUCKY
NORTH CAROLINA
ARIZONA
NEW MEXICO
TEXAS
OKLAHOMA
ARKANSAS
TENNESSEE
SOUTH CAROLINA
GEORGIA
ALABAMA
MISSISSIPPI
LOUISIANA
FLORIDA
KEY
EMISSION DENSITY (metric tons/mi^2)
< 1
1 TO 5
5 TO 10
10 TO 20
> 20
VIRGIN ISLANDS
PUERTO RICO

Figure 6-12. Particulate emission density, by state.

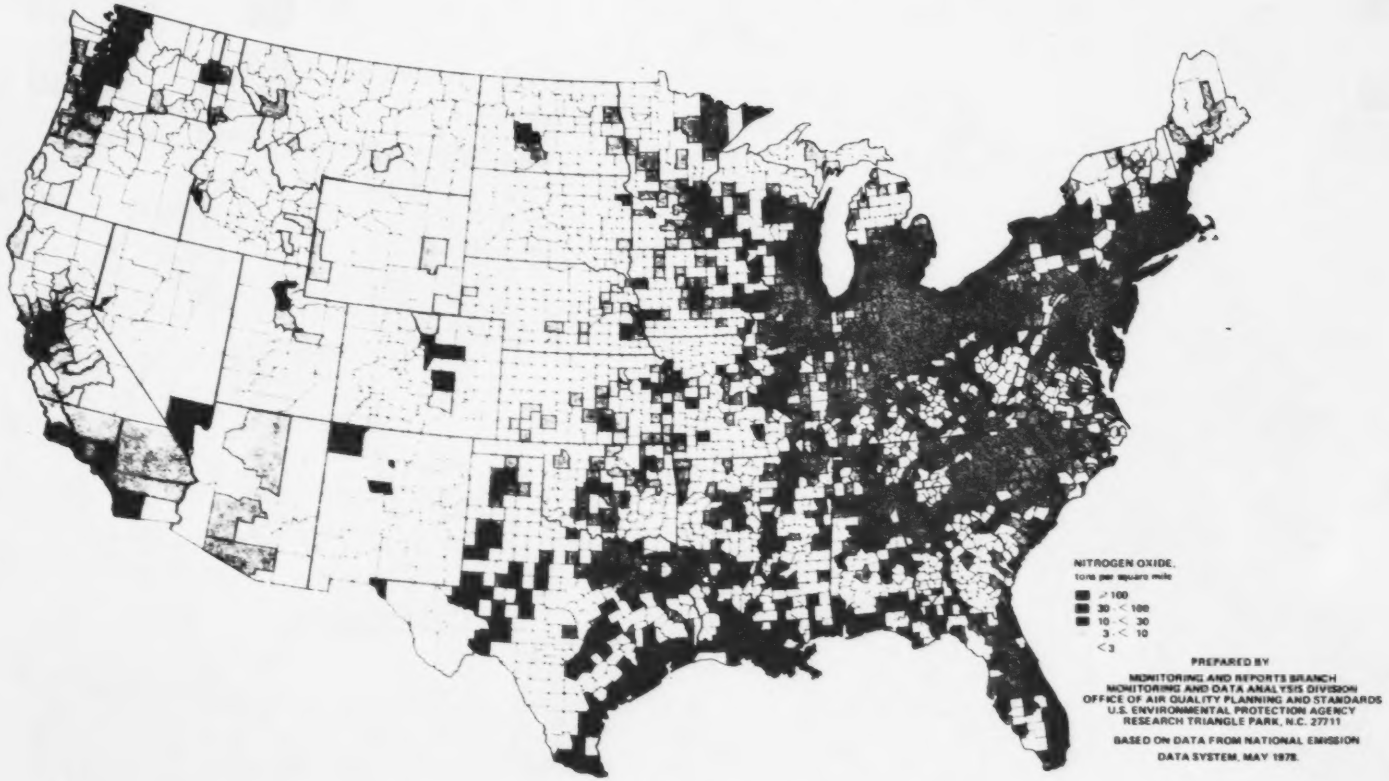

NITROGEN OXIDE,
tons per square mile
≥100
30 - < 100
10 - < 30
3 - < 10
<3
PREPARED BY
MONITORING AND REPORTS BRANCH
MONITORING AND DATA ANALYSIS DIVISION
OFFICE OF AIR QUALITY PLANNING AND STANDARDS
U.S. ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, N.C. 27711
BASED ON DATA FROM NATIONAL EMISSION
DATA SYSTEM, MAY 1978.

Figure 6-13. Nitrogen oxide emission density by county.

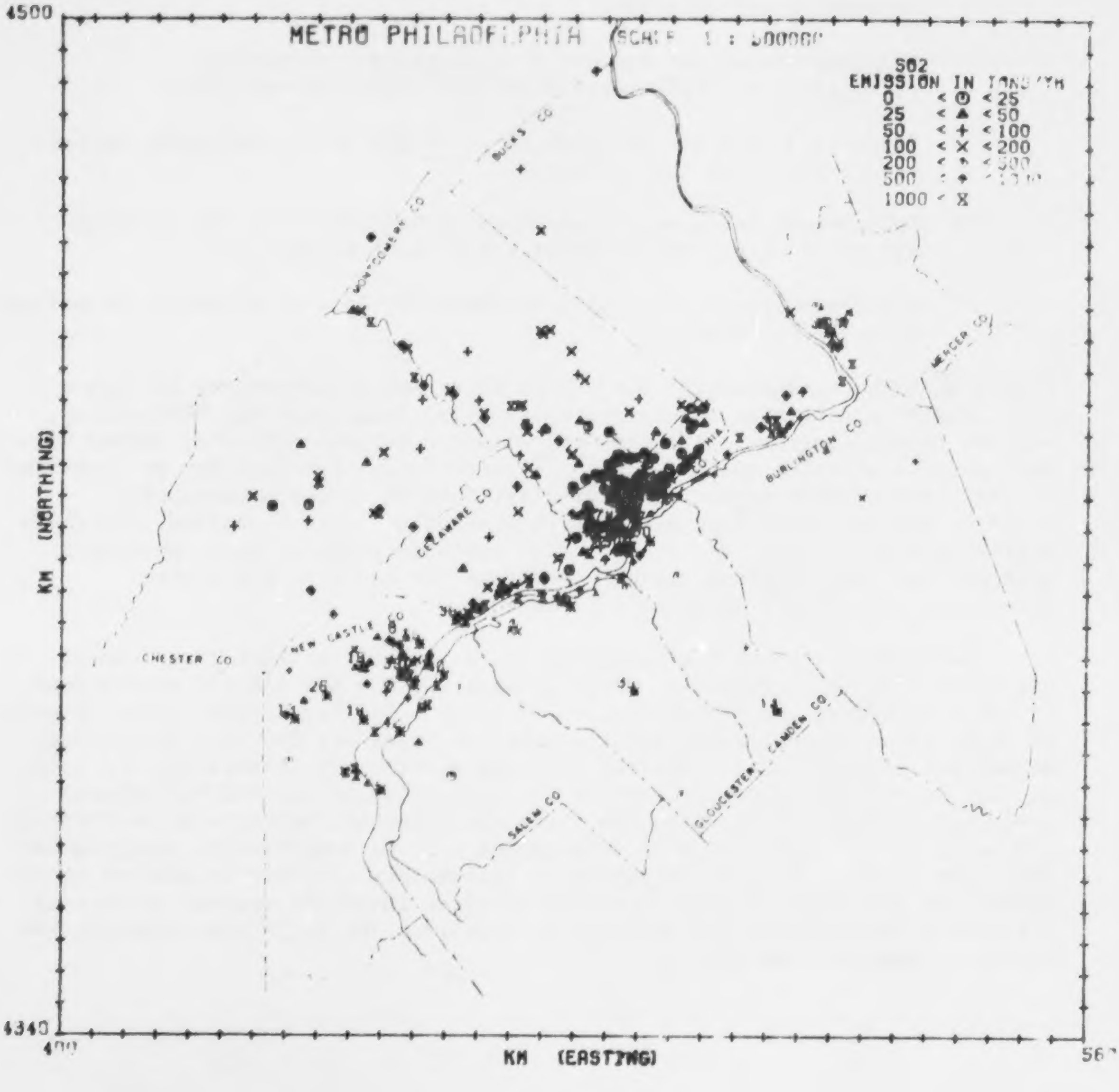

METRO PHILADELPHIA SCALE 1 : 500000
SO2
EMISSION IN TONS/YR
0 < ⊙ < 25
25 < ▲ < 50
50 < + < 100
100 < × < 200
200 < ✱ < 500
500 < ◆ < 1000
1000 < X
4500
4340
400
560
KM (NORTHING)
KM (EASTING)
BUCKS CO
MONTGOMERY CO
DELAWARE CO
CHESTER CO
NEW CASTLE CO
SALEM CO
GLOUCESTER CO
CAMDEN CO
BURLINGTON CO
MERCER CO
PHILADELPHIA

Figure 6-14. Location and emission rate of all plants emitting SO_2.

AQDHS (Air Quality Data Handling Subsystem)--An air quality data base. Prepares a data set for submission to EPA to automatically satisfy agency reporting requirements.

EIS/AS and EIS/PS (Emission Inventory System/Area Sources and Emission Inventory System/Point Sources)[1,7]--A data base describing sources of pollution, levels of pollution, and descriptive data related to permits or registrations.

Supports the agency functions of inspection, complaint investigation, legal compliance, and source surveillance.

Prepares a data set for submission to EPA to automatically satisfy agency reporting requirements.

EMS (Enforcement Management Subsystem)--A data base for use by state and local agencies to control enforcement activities.

Prepares reports, including standardized letters which can be mailed directly to sources.

A typical source printout for the EIS/PS subsystem was presented in Figure 6-1. EIS/PS information requirements are based largely on the NEDS system, and its format contains all source and emission details currently needed to meet various planning and enforcement applications. EIS data can be converted to the required NEDS format automatically, through use of a conversion program, thereby minimizing manpower requirements. Once installed, EIS/PS is extremely easy to use. EPA will provide assistance when a user encounters problems and also provides training sessions for users of the system throughout the country on a periodic basis.

Approximately 15 of the remaining state agencies utilize some form of automated emission inventory. These systems include the AIR-100 system used in New York State, the IBM Air Pollution Control Starter System currently used in Connecticut and Nebraska, and the Illinois Total Air System. The general source and emission data contained in these systems are essentially the same as that for EIS/PS as can be seen by an examination of the AIR-100 printout presented in Figure 6-2. Although there are potential benefits in developing and using an emission inventory data system that is specifically designed for the needs of an agency, it is generally recommended that EIS be adopted by the states now operating without automated emission inventory systems because of its ease of use, widespread acceptance, excellent retrieval capabilities, and available support from EPA.

References for Chapter 6.0

1. The Emissions Inventory System/Point Source User's Guide, EOA-450/4-80-010, U.S. Environmental Protection Agency, Research Triangle Park, NC, May 1980.

2. 1974 National Emissions Data System (NEDS) Fuel Use Report, EPA-450/2-77-031, U.S. Environmental Protection Agency, Research Triangle Park, NC, April 1978.

3. 1977 National Emissions Report, EPA-450/4-80-005, U.S. Environmental Protection Agency, Research Triangle Park, NC, March 1980.

4. Procedures for the Preparation of Emission Inventories for Volatile Organic Compounds, Volume I, Second Edition, EPA-450/2-77-028, U.S. Environmental Protection Agency, Research Triangle Park, NC, March 1980.

5. Systems Study of Air Pollution From Municipal Incineration, APTD 1283, U.S. Environmental Protection Agency, Research Triangle Park, NC, March 1970.

6. The Emission Inventory System/Area Source User's Guide, EPA-450/5-80-009, U.S. Environmental Protection Agency, Research Triangle Park, NC, May 1980.

7.0 MANPOWER/RESOURCE ALLOCATION MODEL

The Time Requirement Model (TREM) for conducting an emission inventory, presented in this chapter, has been developed to assist the planners of the inventory in estimating the manpower requirements needed to achieve the objectives of the inventory. Time requirements, based largely on past experience, are estimated for discrete activities that, in total, comprise the full range of activities involved in preparing an emission inventory.

The time requirement for each defined activity is comprised of both a linear and fixed component. The linear component is a function of the number of sources, and assumes that the time required to perform the operations comprising an activity (e.g., code a form as part of a defined data compilation activity) remains the same throughout the inventory effort. The fixed component is independent of the number of sources and represents the time required; for example, to develop a coding form and/or to write programs to edit and verify the coded data. The fixed time requirement will vary from activity to activity, depending upon the definition of an activity and its associated fixed components. In the example above, the writing of edit and verification programs could logically be classified as a separate activity distinct from coding; e.g., as part of a quality assurance activity. Regardless of the classification of work elements within activities, the general expression for the total time required to perform an activity is given by the general expression

$$TT = T_f + nT_a \qquad (7\text{-}1)$$

where

TT = Total time required to perform an activity

T_f = Fixed time associated with an activity

n = The number of operations required to complete an activity (usually the number of sources or counties within the inventory area)

T_a = Time required to complete an operation within an activity

As an example of the use of Equation 7-1, consider the time involved in preparation of a point source list. The establishment of an initial source list requires that a large number of reference sources (see Chapter 5) must be reviewed to prepare a complete listing of all point sources. A senior engineer will be needed to organize and direct the literature search and to contact facilities to determine if they should be included in the listing of potential point sources. The senior engineer should understand industrial processes within the jurisdiction which are likely to be point sources of emissions. He will be assisted by a junior engineer who will review the literature and identify the facilities and a technician to code and enter the data into a mailing list file.

The fixed time associated with such an activity (T_F) is estimated to be 24 hours of senior engineer time and 80 hours of junior engineer time for a total of 104 hours; the time required to code and install the listing in the file (T_a) is estimated to be 0.04 hour per source. If there are 1000 point sources the time required (nT_a) is 40 hours. Thus TT the total time required initially to develop a point source listing is 144 hours.

$$TT = 104 + 1000\ (0.04) = 144$$

The maintenance of the initial listing will require far less effort. Estimates of the fixed time associated with an activity is 8 hours of senior engineer and 20 hours of junior engineer time. The time required to code and install new sources (or delete sources) is the same as for the initial effort (0.04 hours per source), but the number of sources will generally be far less than the initial number. If 100 sources are added to the point source listing the total maintenance effort is

$$TT = 28 + 100\ (0.04) = 32 \text{ hours.}$$

The model expression, Equation 7-1, is presented graphically in Figure 7-1. The time requirement for an activity will depend not only upon the number of sources and counties to be inventoried, but will also depend upon the following:

Level of detail required,

Skill of personnel,

Availability of data,

Status of existing inventory,

Status of existing data handling system,

Status of existing quality assurance program.

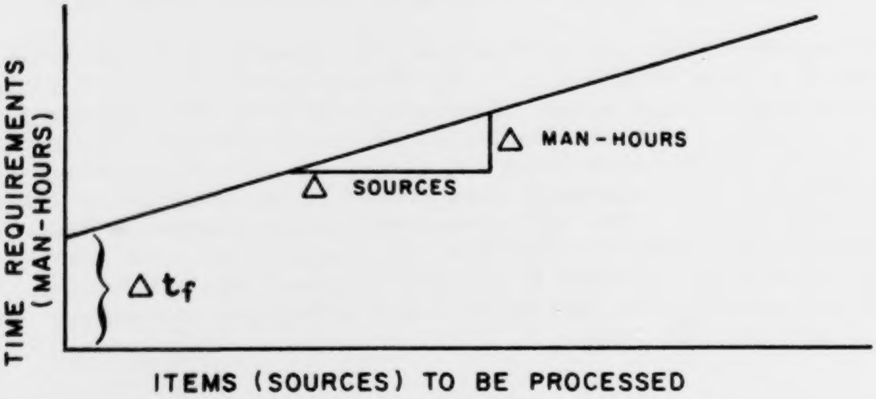


Figure 7-1. Time requirement model—graphical representation.

The agency will be required to make some judgments concerning the above factors and adjust the time requirements of the TREM as presented in this chapter. When an agency has conducted inventories regularly, its past experience can be used to estimate time requirements. If an agency desires additional information concerning time and manpower requirements, information can be found in the published literature.[1,2,3] In addition, a computer model is available from EPA which estimates technical and administrative costs associated with preparing emission inventories. To obtain additional information, contact an EPA Regional Office or the Control Programs Operations Branch, Control Process and Development Division, MD-15, U.S. Environmental Protection Agency, Research Triangle Park, NC, 27711.

The activities involved in developing the total inventory of point, area and mobile sources are listed in Table 7-1, along with the results of the TREM analysis for each activity. Each of these activities, referred to in the model as a "task,", is discussed separately, specific assumptions defined, and time requirements estimated for both an initial inventory (TT_I) and an inventory maintenance effort (TT_M). Each task (activity) presentation is formatted to provide the information listed below.

1. Task: Name of the task.

2. Task overview: A general overview of the activities included in the task and any special instructions for interpreting and using the included information.

3. Occupational category: The educational background of agency personnel; e.g., senior or junior engineer or computer software specialist.

4. Knowledge and skill requirements: Additional knowledge and experience of personnel required to effectively perform the task.

5. Time requirements: TREM determined manpower requirements for both the initial effort and the maintenance effort.

TABLE 7-1. TIME REQUIREMENT MODEL (TREM) SUMMARY

	Initial effort TT_I (hours)	Maintenance effort TT_M (hours)
Point Source Inventory		
Establishment of a source list	104 + 0.04n	28 + 0.04n
Development of a questionnaire	56	16
Printing mailing list and labels	8 + 0.0005n	1 + 0.0005n
Mail questionnaires	0.02n	0.02n
Logging and review of returns	8 + 0.2n	0.2n
Assignment of codes	40 + 0.1n	0.1n
Data coding	40 + 0.3n	0.2n
Calculation of emissions	40 + 0.5n	0.3n
Quality assurance	16 + 0.02n	16 + 0.02n
Data presentation	40	40
Area Source Inventory		
Data collection	80 + 0.25n	0.25n
Program compilation		
Existing software	0.25 + 0.001n	0.25 + 0.001n
New software	40 + 0.001n	0.25 + 0.001n
Data coding	40 + 0.75n	0.75n
Software development		
Existing software	80 + 0.2n	0.2n
New software	280 + 0.2n	8 + 0.2n
Calculation of emissions		
Manual approach	40 + 8n	20 + 6n
Computerized approach	20 + 0.2n	20 + 0.2n
Quality assurance	20 + 1n	20 + 1n
Data presentation	80	80
Mobile Source Inventory		
Establishment of liasons with other agencies	120	120
Data collection	80 + 0.25n	0.25n
Data coding	40 + 0.75n	0.75n
Software development		
Existing software	80 + 0.2n	0.2n
New software	280 + 0.2n	8 + 0.2n
Calculation of emissions		
Manual approach	40 + 8n	20 + 6n
Computerized approach	40 + 0.1n	8 + 0.1n
Quality assurance	20 + 1n	20 + 1n
Data presentation	80	80

TIME REQUIREMENT MODEL
BY ACTIVITY FOR POINT SOURCES

TIME REQUIREMENT MODEL BY ACTIVITY: Point Sources

TASK: Establishment of a source list

TASK OVERVIEW: The establishment of an intial source list is a time-consuming task. A large number of references (see Chapter 5) must be consulted and cross-checked to ensure that all sources are included. Although the number of sources in the listing can be limited by judicious selection of a cutoff size for each source category, based on an indicator such as employment, a large initial effort is worthwhile. An expanded listing will prove helpful in reducing the effort required by the agency if, for example, the point source emission level is lowered in future programs. Accordingly, it is recommended that, in preparing the point source list, a conservative estimate of emissions vs. employment (or other indicator) be adopted for preparation of the initial mailing list. Plant names, addresses, telephone numbers and contacts must be assembled, and, if possible, coded and keypunched for further use.

OCCUPATIONAL CATEGORY: A senior engineer to organize and direct the literature search and contact facilities, when necessary; a junior engineer to review the literature and identify the facilities to be listed; a technician to either code or photostat acquired data; and a keypunch operator.

KNOWLEDGE AND SKILL REQUIREMENTS: In addition to a knowledge of process emissions, a knowledge of demographic data is important, along with some statistical knowledge, in order to assess factors that would identify the emission potential of a company.

TIME REQUIREMENT:(1) Initial effort

$$TT_I = T_f + nT_a$$

T_f = 24 hr of senior engineer
+ 80 hr of junior engineer, 104 hr

T_a = 1 hr/50 sources to photostat or code
+ 1 hr/50 sources to keypunch; 2 hr/50 sources or 0.04 hr/source

n = number of sources

$$TT_I = 104 + 0.04n \text{ hr}$$

(2) Maintenance effort

$$TT_M = T_f + nT_a$$

T_f = 8 hr of senior engineer
+ 20 hr of junior engineer, 28 hr

T_a = 2 hr/100 sources, to photostat or code necessary changes + 2 hr/100 sources to keypunch, 4 hr/100 sources; 0.02 hr/source

n = number of sources

$$TT_M = 28 + 0.04n \text{ hr}$$

TIME REQUIREMENT MODEL BY ACTIVITY: Point Sources

TASK: Development of a questionnaire(s)

TASK OVERVIEW: This activity involves a one-time effort to create a simple questionnaire(s) to gather all necessary source data. Alternatively, standard questionnaires, such as those described in Volume II,[4] could be used. For maintenance purposes, this activity requires the development of a miniquestionnaire that includes such data items as a fuel update and changes in process or control equipment.

OCCUPATIONAL CATEGORY: A senior engineer to develop the questions, a principal engineer to review them, and a computer specialist to assist in the formatting of the questionnaire for subsequent computerization of the data.

KNOWLEDGE AND SKILL REQUIREMENTS: A knowledge of processes, air pollution technologies, and source evaluation ability are essential.

TIME REQUIREMENT: (1) Initial effort

$$TT_I = T_f + nT_a$$

In this activity n = 1 (one-time activity), so this equation reduces to

$$TT_I = T_f + T_a$$

Based on the past experience of several agencies, this time requirement involves:

5 days of senior engineer time;
1 day of principal engineer time; and
1 day of computer specialist time.

TT_I = 7 days, or 56 hr

(2) Maintenance effort

The time requirement for maintenance effort could involve:

1 day of senior engineer time;
1/2 day of principal engineer/scientist time; and
1/2 day of computer specialist time.

TT_M = 2 days, or 16 hr

TIME REQUIREMENT MODEL BY ACTIVITY: Point Sources

TASK: Printing mailing list and labels

TASK OVERVIEW: This activity involves a one-time software development effort to create a mailing list and labels. For maintenance purpose, it only requires the execution and running of the developed program. The mailing labels are preferably keyed by an ID and SIC number to facilitate logging of returns.

OCCUPATIONAL CATEGORY: A junior programmer

KNOWLEDGE AND SKILL REQUIREMENTS: A knowledge of either FORTRAN or COBOL computer language is essential to carry out this activity. A programmer should also be able to use available computer software packages such as EASYTRIEVE, SPSS, etc.

TIME REQUIREMENT: (1) Initial effort

$$TT_I = T_f + nT_a$$

T_f = 8 hr if FORTRAN is used,
6 hr if COBOL is used

T_a = 0.25 hr/500 labels, or
0.0005 hr/label

n = number of labels (sources)

$$TT_I = 8 + 0.0005n$$

(2) Maintenance effort

$$TT_M = T_f + nT_a$$

T_f = 1 hr, considerably less than initial effort since a software package has been developed. A programmer must assemble the previously developed program, use JCL (Job Control Language) and create a source list and mailing labels

T_a = 0.0005 hr/label; remains unchanged

n = number of labels (sources)

$$TT_M = 1 + 0.0005n \text{ hr}$$

TIME REQUIREMENT MODEL BY ACTIVITY: Point Source

TASK: Mail questionnaire

TASK OVERVIEW: This is a very simple task. It involves attaching the preprinted label to a questionnaire, placing the questionnaire in an envelope and attaching a second label, identical to the first, to the mailing envelope, which is then mailed.

OCCUPATIONAL CATEGORY: A technician or member of the support services staff

KNOWLEDGE AND SKILL REQUIREMENTS: None

TIME REQUIREMENT: The total time required for the initial effort and for the maintenance effort is the same.

$$TT_I = TT_M = T_f + nT_a$$

There is no T_f time associated with this task; all effort is related to the number of questionnaires being mailed.

$$TT_I = TT_M = nT_a$$

T_a = 1 min per source, or 0.02 hr/source

n = number of sources

$$TT_I = TT_M = 0.02n \text{ hr}$$

TIME REQUIREMENT MODEL BY ACTIVITY: Point Sources

TASK: Logging and review of returns

TASK OVERVIEW: Questionnaires will be logged in and reviewed once they are received. The purpose of the review is to ensure that all questions have been properly answered. It does not involve an in-depth technical review which will be done by personnel responsible for data coding and emissions calculations.

OCCUPATIONAL CATEGORY: A junior engineer reviews incoming questionnaires and a technician logs them in.

KNOWLEDGE AND SKILL REQUIREMENTS: Some process knowledge, plus a general knowledge of the geographic area, including familiarity with the local industrial base.

TIME REQUIREMENT: (1) Initial effort

$TT_I = T_f + nT_a$

T_f = fixed time required to set up techniques for logging and review system, 8 hr

T_N = 2 min for logging/source, and
10 min for review/source;
12 min, or
0.2 hr/source

n = number of sources

$TT_I = 8 + 0.2n$ hr

(2) Maintenance effort

$TT_M = T_f + nT_a$

T_f = 0, techniques have already been determined and documented.

T_a = 0.02 hr/source, same as initial case

n = number of sources

$TT_M = 0.2n$ hr

TIME REQUIREMENT MODEL BY ACTIVITY: Point Sources

TASK: Assignment of codes

TASK OVERVIEW: This activity involves the study of a source and its related processes to determine the most applicable source classification codes (SCC). A senior engineer must thouroughly familiarize himself with the SCC coding system in order to assign the appropriate code. At the same time, a junior engineer or programmer assigns the necessary systems codes such as plant identification, city, county, state codes, etc.

OCCUPATIONAL CATEGORY: A senior engineer to assign SCC; a junior engineer or programmer to assign system identification codes.

KNOWLEDGE AND SKILL REQUIREMENTS: A knowledge of industrial processes is helpful for assigning SCC codes. A general knowledge of data recording techniques is essential for assigning geographic and system indicator codes.

TIME REQUIREMENT: (1) Initial effort

$TT_I = T_f + nT_a$

T_f = 40 hr, for familiarization with SCC designations.

T_a = 5 min to assign SCC codes per source + 1 min to assign state, county, city codes per source
= 6 min per source, or 0.1 hr per source

n = number of sources

$TT_I = 40 + 0.1n$ hr

(2) Maintenance effort

$TT_M = T_f + nT_a$

T_f = 0, as the familiarization process is assumed to be complete

T_a = identical to initial effort
= 0.1 hr/source

n = number of sources

$TT_M = 0.1n$ hr

TIME REQUIREMENT MODEL BY ACTIVITY: Point Sources

TASK: Data coding

TASK OVERVIEW: All source data must be coded and entered into a computerized data handling system. Regardless of the emission inventory system used (NEDS, EIS, individual state system, etc.), coding and keypunching of data items is an essential processing step.

OCCUPATIONAL CATEGORY: A junior engineer/scientist, a keypunch operator.

KNOWLEDGE AND SKILL REQUIREMENTS: A Senior Engineer who knows the industries and processes within the region will be required to ensure that the all of the data entered into the file is complete and technically correct. He will assist the two junior engineers in dealing with uncertainties and will recontact facilities as required. This operation should be carried out in adherence to documented procedures. Familiarity with the computer load sheet formats (assumed available) and data codes employed by agency for control devices, test procedures, etc. will be necessary.

TIME REQUIREMENT: (1) Initial effort

$TT_I = T_f + nT_a$

T_f = time required to understand coding forms and procedures, 40 hr

T_a = 15 min to code each source
+ 5 min to keypunch each source;
20 min per source or 0.3 hr/source

n = number of sources

$TT_I = 40 + 0.3n$ hr

(2) Maintenance effort

$TT_M = T_f + nT_a$

T_f = 0, this assumed trained personnel are available

T_a = extremely variable since the number of keypunch cards to be modified may vary from 1 to 6, depending upon the data to be modified. An average maintenance effort is 10 to 15 min/source, or 0.2 hr/source

n = number of sources

$TT_M = 0.2n$ hr

TIME REQUIREMENT MODEL BY ACTIVITY: Point Sources

TASK: Calculation of emissions

TASK OVERVIEW: This activity involves estimating emission rates from various sources and source categories using either AP-42 or other emission factors developed for the industry. It is an engineering activity, requiring an initial high expenditure of manpower. With time, however, the activity becomes increasingly more routine.

OCCUPATIONAL CATEGORY: A senior engineer, a junior engineer.

KNOWLEDGE AND SKILL REQUIREMENTS: A knowledge of processes and controls, material balance and dimension analysis are important. Familiarity with conversion factors is also important.

TIME REQUIREMENT: (1) Initial effort

$$TT_I = T_f + nT_a$$

T_f = time required to develop an understanding of AP-42, or similar reference materials, 40 hr

T_a = 0.5 hr/source to calculate source emission rates

n = number of sources

$$TT_I = 40 + 0.5n \text{ hr}$$

(2) Maintenance effort

$$TT_M = T_f + nT_a$$

T_f = 0, as the familiarization process is assumed to be complete

T_a = 0.3 hr/source; once the calculation techniques are learned, the time requirement is approximately 60 percent of the initial effort.

n = number of sources

$$TT_M = 0.3n \text{ hr}$$

TIME REQUIREMENT MODEL BY ACTIVITY: Point Sources

TASK: Quality assurance*

TASK OVERVIEW: The objective of this task is to ensure that all data are complete and correct. There are visual checks and edit program check procedures. This task involves running previously developed QA programs.

OCCUPATIONAL CATEGORY: A senior programmer.

KNOWLEDGE AND SKILL REQUIREMENTS: A knowledge of the use of program packages, and also of FORTRAN or some other computer language.

TIME REQUIREMENT: Initial and maintenance efforts are always the same.

$$TT_I = TT_M = T_f + nT_a$$

T_f = time required to set up and execute programs, 16 hr

T_a = 1 min/source, or 0.02 hr/source

n = number of sources

$$TT_I = TT_M = 16 + 0.02n \text{ hr}$$

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*This action only performs machine edits and validity checks on coded information and is not the quality assurance that must be performed manually by competent engineers responsible for data review and coding.

TIME REQUIREMENT MODEL BY ACTIVITY: Point Sources

TASK: Data presentation

TASK OVERVIEW: Once all data on point sources have been assembled, reports are generated which present these data in predetermined formats.

OCCUPATIONAL CATEGORY: Senior engineer.

KNOWLEDGE AND SKILL REQUIREMENTS: Good communication skills and knowledge of the data requirements of an agency are important.

TIME REQUIREMENT: $TT_I = TT_M = T_f + nT_a$

The generation of a specific report will always require the same amount of time. This time will vary, depending on the number of sources in the inventory. It is estimated that, on the average, this task will require 40 hr for all reporting.

$TT_I = TT_M = 8$ hr

TIME REQUIREMENT MODEL
BY ACTIVITY FOR AREA SOURCES

TIME REQUIREMENT MODEL BY ACTIVITY: Area Sources

TASK: Data collection

TASK OVERVIEW: Assuming that data needs have been identified, the data collection activity begins. Data logging activities for received data is included in this activity.

OCCUPATIONAL CATEGORY: A senior engineer and a technician.

KNOWLEDGE AND SKILL REQUIREMENTS: Communication skills and a knowledge of demographic data.

TIME REQUIREMENT: (1) Initial effort

$$TT_I = T_f + nT_a$$

T_f = time required to identify data source contacts and verify information or obtain missing information by telephone, 80 hr

T_N = time required to compile and log in data is 15 minutes or 0.25 hr/county

n = number of counties

$$TT_I = 80 + 0.25n \text{ hr}$$

(2) Management effort

$$TT_M = T_F \; T_n T_N$$

T_F = 0, techniques have been determined and personnel are familiar with them

T_N = 0.25 hr/source, same as initial case

$$TT_M = 0.25n \text{ hr}$$

TIME REQUIREMENT MODEL BY ACTIVITY: Area Sources

TASK: Program compilation

TASK OVERVIEW: The development of an area source inventory requires compilation of previously developed programs.

OCCUPATIONAL CATEGORY: A senior programmer.

KNOWLEDGE AND SKILL REQUIREMENTS: A knowledge of either FORTRAN or any assembly language is essential.

TIME REQUIREMENT: (1) $TT_{initial} = T_f + nT_a$

T_f = program setup time, 0.25 hr

T_a = time to run program, 0.001 hr/county

n = number of counties

$TT_I = 0.25 + 0.001n$ hr

This is the time requirement if the language and the system are the same as the original program. If the language or the system is different, then the following time estimate to modify and test the software on the agency's system should be used.

(2) $TT_{initial} = T_f + nT_a$

T_f = software setup and debugging time, 40 hr

T_a = time to execute program, 0.001 hr/county

n = number of counties

$TT_{initial} = 40 + 0.001n$ hr

(3) $TT_M = T_f + nT_a$

The maintenance effort for either case (1) or (2) above is the same, inasmuch as a system and a language will have been chosen.

T_f = setup time for the program, 0.25 hr

T_a = time to execute the program, 0.001 hr/county

n = number of counties

$$TT_M = 0.25 + 0.001n \text{ hr}$$

TIME REQUIREMENT MODEL BY ACTIVITY: Area Sources

TASK:	Data coding
TASK OVERVIEW:	If a computerized system is used, it is necessary to code data as required by the system, using a coding form designed for the system. The coded data must be keypunched.
OCCUPATIONAL CATEGORY:	Junior engineer, a keypunch operator.
KNOWLEDGE AND SKILL REQUIREMENTS:	A knowledge of coding and computer systems is helpful.
TIME REQUIREMENT:	(1) Initial effort

$TT_I = T_f + nT_a$

T_f = 40 hr, a junior engineer is required

T_a = 30 min to code each county + 15 min to keypunch each county; 45 min/county or 0.75 hr/county

n = number of counties

$TT_I = 40 + 0.75n$ hr

(2) Maintenance effort

$TT_M = T_f + nT_a$

T_f = 0, since the engineer is already aware of the coding needs.

T_a = the same as initial effort, 0.75 hr/county

n = number of counties

$TT_M = 0.75n$ hr

TIME REQUIREMENT MODEL BY ACTIVITY: Area Sources

TASK: Software development for apportioning data on a county level (or grid level)

TASK OVERVIEW: This activity is necessary if an area has many counties, and area source data must be apportioned to each. The activity can be broken down into (1) developing software and (2) use of existing programs.

OCCUPATIONAL CATEGORY: A junior programmer, a senior programmer.

KNOWLEDGE AND SKILL REQUIREMENTS: A knowledge of programming and SPSS, or similar packages is essential.

TIME REQUIREMENT: (1) Developing software

(a) Initial effort

$TT_I = T_f + nT_a$

T_f = 280 hr, time required to understand, set up, develop, and compile a program

T_a = 0.2 hr/county

n = number of counties

$TT_I = 280 + 0.2n$ hr

(b) Maintenance effort

$TT_M = T_f + nT_a$

T_f = 8 hr, there is no need to develop a program since this activity is only involved with compiling programs and executing them.

T_a = identical to that of the initial effort, 0.2 hr/county

n = number of counties

$TT_M = 8 + 0.2n$ hr

(2) Use of previously developed programs

(a) Initial effort

$TT_I = T_f + nT_a$

T_f = 80 hr, to understand, install and compile existing programs

T_a = remains the same, 0.2 hr/county

n = number of counties

$TT_I = 80 + 0.2n$ hr

(b) Maintenance effort

$TT_M = T_f + nT_a$

$T_f = 0$

T_a = remains the same, 0.2 hr/county

n = number of counties

$TT_M = 0.2n$ hr

TIME REQUIREMENT MODEL BY ACTIVITY: Area Sources

TASK: Calculation of emissions

TASK OVERVIEW: Two ways to calculate emissions are (1) manually and (2) computerized. If an agency uses a computer for coding and apportioning data, it should use the computer to calculate emissions. Emission factors can be built into the program.

OCCUPATIONAL CATEGORY: A junior engineer, senior engineer--Manual System
A junior programmer, senior programmer--Computerized System

KNOWLEDGE AND SKILL REQUIREMENTS: Use of emission factors and understanding of basic programming, using standard packages.

TIME REQUIREMENT: (1) Manual approach

(a) Initial effort

$TT_I = T_f + nT_a$

T_f = 40 hr to understand the use of AP-42 emission factors

T_a = 8 hr for calculating emissions for all area source activities in each county

n = number of counties

$TT_I = 40 + 8n$ hr

(b) Maintenance effort

$TT_M = T_f + nT_a$

T_f = 20 hr, as familiarity with the use of emission factors will decrease the time

T_a = 6 hr/county, since this task becomes routine

n = number of counties

$TT_M = 20 + 6n$ hr

(2) Computerized approach

$TT_I = TT_M = T_f + nT_a$

Initial and maintenance efforts are the same since computer programs have been previously developed. Execution, startup, compilation and running time will be identical.

$T_f = 20$ hr

$T_a = 0.2$ hr/county

n = number of counties

$TT_I = TT_M = 20 + 0.2n$ hr

TIME REQUIREMENT MODEL BY ACTIVITY: Area Sources

TASK: Quality assurance

TASK OVERVIEW: The objective of this task is to make sure all data are correct. Spot checks of data, and edit check programs can be used.

OCCUPATIONAL CATEGORY: A senior programmer.

KNOWLEDGE AND SKILL REQUIREMENTS: A knowledge of program packages and how to use them is necessary.

TIME REQUIREMENT: $TT_I = TT_M = T_f + nT_a$

Initial and maintenance efforts will be the same.

T_f = 20 hr to understand, setup and execute program

T_a = 1 hr/county

n = number of counties

$TT_I = TT_M = 20 + 1n$ hr

TIME REQUIREMENT MODEL BY ACTIVITY: Area Sources

TASK: Data presentation

TASK OVERVIEW: A report, which is a one-time effort, is generated after all data are put together. This report documents an area source emission inventory.

OCCUPATIONAL CATEGORY: Senior engineer.

KNOWLEDGE AND SKILL REQUIREMENTS: Good communication skills and an awareness of agency data needs are important.

TIME REQUIREMENT: $TT_I = TT_M = T_f + nT_a$

Initial and maintenance efforts are the same. Both are one-time efforts, which are essentially unrelated to the number of counties in the area.

$T_f = 80$ hr. This is an estimate based on average report lengths.

$TT_I = TT_M = 80$ hr

TIME REQUIREMENT MODEL
BY ACTIVITY FOR MOBILE SOURCES

TIME REQUIREMENT MODEL BY ACTIVITY: Mobile Sources

TASK: Establishment of liaisons with other agencies

TASK OVERVIEW: The development of a mobile source inventory involves some coordination with other agencies. Management in the emission inventory agency should contact other federal, state and local agencies and request their support.

OCCUPATIONAL CATEGORY: A principal engineer.

KNOWLEDGE AND SKILL REQUIREMENTS: Good communication skills and the ability to work with other agency personnel.

TIME REQUIREMENT: $TT_I = TT_M = T_f + nT_a$

Initial and maintenance efforts always remain the same. This effort continues for the entire process of developing and/or maintaining the emission inventory.

$T_f = 120$ hr

$T_a = 0$, as this task is not related to the number of counties included in the inventory

$TT_I = TT_M = 120$ hr

TIME REQUIREMENT MODEL BY ACTIVITY: Mobile Sources

TASK: Data collection

TASK OVERVIEW: This task involves contacting people and agencies to obtain the required data. A log of data that are requested and received should be maintained. Verification of received data is also required.

OCCUPATIONAL CATEGORY: A junior engineer and a technician.

KNOWLEDGE AND SKILL REQUIREMENTS: Communication skills and a knowledge of traffic data.

TIME REQUIREMENT: (1) Initial effort

$$TT_I = T_f + nT_a$$

T_f = 80 hr, the time to identify contacts

T_a = 0.25 hr/county, the time to request, log and verify data

n = number of counties

$$TT_I = 80 + 0.25n \text{ hr}$$

(2) Maintenance effort

$$TT_M = T_f + nT_a$$

T_f is zero, while T_a remains the same as that for the initial effort.

$$TT_M = 0.25n \text{ hr}$$

TIME REQUIREMENT MODEL BY ACTIVITY: Mobile Sources

TASK:	Data coding
TASK OVERVIEW:	Coding and keypunching data for the computer, or a program (MOBIL1 or APRAC, etc.), to calculate emissions for on-highway and off-highway sources; coded data are keypunched.
OCCUPATIONAL CATEGORY:	A junior programmer, a keypunch operator.
KNOWLEDGE AND SKILL REQUIREMENTS:	Coding skills and an understanding of coding forms.

(1) Initial effort

$TT_I = T_f + nT_a$

T_f = 40 hr, junior programmer to review and develop familiarity with techniques

T_a = 30 min/county to code and 15 min/county to keypunch; 45 min/county or 0.75 hr/county

n = number of counties

$TT_I = 40 + 0.75\ n$ hr

(2) Maintenance Effort

$TT_M = T_f + nT_a$

T_f is not necessary, since the junior programmer has already established the mechanism for coding data. T_a remains the same as in the case of the initial effort.

T_a = 0.75 hr/county

n = number of counties

$TT_M = 0.75n$ hr

TIME REQUIREMENT MODEL BY ACTIVITY: Mobile Sources

TASK: Software development for apportioning data on a county level (or grid level)

TASK OVERVIEW: This activity can be broken down into two tasks: (1) development of necesary software and (2) use of previously developed programs.

OCCUPATIONAL CATEGORY: A senior programmer, a junior transportation programmer.

KNOWLEDGE AND SKILL REQUIREMENTS: A knowledge of transportation programming and skill in the use of SPSS or similar packages is helpful.

TIME REQUIREMENT: (1) Developing software

(a) Initial effort

$$TT_I = T_f + nT_a$$

T_f = 280 hr, time for a programmer to understand the data needs of an agency and then develop a program

T_a = time required for each county 0.2 hr/county

n = number of counties

$$TT_I = 280 + 0.2n \text{ hr}$$

(b) Maintenance effort

$$TT_M = T_f + nT_a$$

T_f = 8 hr, the time to compile a program, use a data set and execute the programs

T_a = 0.2 hr/county; remains the same

n = number of counties

$$TT_M = 8 + 0.2n \text{ hr}$$

(2) Use of previously developed programs

(a) Initial effort

$TT_I = T_f + nT_a$

T_f = 80 hr, the time to understand, install, and test the programs on the agency's computer system

T_a = computer time for each county, 0.2 hr/county; remains the same

n = number of counties

$TT_I = 80 + 0.2n$ hr

(b) Maintenance effort

$TT_M = T_f + nT_a$

T_f = 0, as the programs have been compiled

T_a = same as for the initial effort, 0.2 hr/county

n = number of counties

$TT_M = 0.2n$ hr

TIME REQUIREMENT MODEL BY ACTIVITY:	Mobile Sources
TASK:	Calculation of emissions
TASK OVERVIEW:	There are two ways to calculate emissions: (1) manually and (2) using a computer with MOBIL1, APRAC, or some other program.
OCCUPATIONAL CATEGORY:	A junior engineer, senior engineer--Manual A junior programmer, senior programmer--Computerized
KNOWLEDGE AND SKILL REQUIREMENTS:	Understanding and use of emission factors; also basic programming skills using standard packages.
TIME REQUIREMENT:	(1) Manual approach

(a) Initial effort

$TT_I = T_f + nT_a$

T_f = 40 hr, to understand all the emission factors and use of conversion factors

T_a = 8 hr/county, for calculating emissions for on-highway and off-highway sources

n = number of counties

$TT_I = 40 + 8n$ hr

(b) Maintenance effort

$TT_M = T_f + nT_a$

T_f = 20 hr, activity has become routine

T_a = 6 hr/county, less for the same reason

n = number of counties

$TT_M = 20 + 6n$ hr

(2) Computerized approach

(a) Initial effort

$TT_I = T_f + nT_a$

T_f = 40 hr, the time required to install a program on the system and get it working

T_a = 0.1 hr/county

n = number of counties

$TT_I = 40 + 0.1n$ hr

(b) Maintenance effort

$TT_M = T_f + nT_a$

T_f = 8 hr, time is reduced because the program is already installed.

T_a = 0.1 hr/county; remains the same

n = number of counties

$TT_M = 8 + 0.1n$ hr

TIME REQUIREMENT MODEL BY ACTIVITY: Mobile Sources

TASK: Quality assurance

TASK OVERVIEW: The objective of this task is to make sure the quality of the data is acceptable. Input data should be either spot checked, or reviewed through edit check programs.

OCCUPATIONAL CATEGORY: A senior programmer.

KNOWLEDGE AND SKILL REQUIREMENTS: Knowledge of edit program packages and their use.

TIME REQUIREMENT: Initial and maintenance efforts are the same.

$$TT_I = TT_M = T_f + nT_a$$

T_f = 20 hr, the time to understand and set up programs

T_a = 1 hr/county; to check input data and flag errors

n = number of counties

$$TT_I = TT_M = 20 + 1n \text{ hr}$$

TIME REQUIREMENT MODEL BY ACTIVITY: Mobile Sources

TASK: Data presentation

TASK OVERVIEW: A report which is a one-time effort is generated after all data are combined and emissions calculated. This report documents the mobile source emission inventory.

OCCUPATIONAL CATEGORY: Senior engineer.

KNOWLEDGE AND SKILL REQUIREMENTS: Good writing skills and an understanding of agency needs.

TIME REQUIREMENT: $TT_I = TT_M = T_f + nT_a$

T_f = 80 hr, time required to write a summary report, which is the same for initial and maintenance efforts

T_a = 0, as the report is not dependent upon the number of counties surveyed

$TT_I = TT_M = 80$ hr

APPENDIX A

DEFINITIONS

This section provides definitions of terms employed by air pollution control agencies in conducting emission inventories and related regulatory functions. The terms presented in Appendix A provide a working basis for consistency among local, state and Federal agencies.

The words and terms listed in Appendix A were collected from various publications such as the Federal Register, EPA Documents and Manuals, State Implementation Plans, and the Clean Air Act. The references served to identify terminilogy used by Federal and State Governments in regulations governing air pollution control and prevention.

Term	Definition	Reference
ACTIVITY LEVEL	Rate relating the amount of fuel consumed, quantity of product manufactured in an industrial process, or some comparative measure.	EPA-450/2-78-026
ADEQUATELY WETTED	Sufficiently mixed or coated with water or an aqueous solution to prevent dust emissions.	40 CFR 61.02
AFFECTED FACILITY	With reference to a stationary source, any apparatus to which a standard is applicable.	40 CFR 60.2
AIR POLLUTANT	Any air pollution agent or combination of such agents, including any physical, chemical, biological, radioactive (including source material, special nuclear material, and byproduct material) substance or matter which is emitted into or otherwise enters the ambient air.	Clean Air Act Sec. 302(g)
AIR POLLUTION REQUIREMENT	Any emission limitation, schedule or timetable for compliance, or other requirement, which is prescribed under any Federal, state, or local law or regulation, including the Act* (except for any requirement prescribed under section 119 (c) or (d), Section 110(a)(2)(F)(v), or Section 303 of the Act), and which limits stationary source emissions resulting from combustion of fuels (including a prohibition on, or specification of, the use of any fuel or any type, grade, or pollution characteristic).	40 CFR 55.02
AIR QUALITY CONTROL REGION (AQCR)	Designated by the Administrator pursuant to Sec. 107 of the Clean Air Act, for air quality planning purposes.	40 CFR 81

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*Clean Air Act

Term	Definition	Reference
ALLOWABLE EMISSIONS	The emission rate calculated using the maximum rated capacity of the source (unless the source is subject to enforceable permit conditions which limit the operating rate or hours of operation or both) and the most stringent of the following: (i) Applicable standards as set forth in 40 CFR Part 60 and Part 61 (NSPS, NESHAPS), (ii) The applicable State Implementation Plan emission limitation, or (iii) The emission rate specified as a permit condition.	40 CFR 51.23
ALTERNATIVE METHOD	Any method of sampling and analyzing for an air pollutant which is not a reference or equivalent method but which has been demonstrated to the Administrator's* satisfaction to, in specific cases, produce results adequate for his determination of compliance.	40 CFR 60.2
AMBIENT AIR	That portion of the atmosphere external to buildings to which the general public has access.	40 CFR 50.1
AREA SOURCE	Any small residential, governmental, institutional, commercial, or industrial fuel combusion operations; onsite solid waste disposal facility; motor vehicles, aircraft, vessels, or other transportation facilities; or other miscellaneous sources such as those listed in Appendix D of 40 CFR 51, and as identified through inventory techniques similar to those described in: "A Rapid Survey Technique for Estimating Community Air Pollution Emissions," Public Health Service Publication No. 999-AP-29, October 1966.	40 CFR 51.1

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*Administrator of EPA.

Term	Definition	Reference
	APPENDIX D LISTING	
AREA SOURCE (cont.)	(i) Fuel combustion -- stationary source: Anthracite coal, bituminous coal, distillate oil, residual oil, natural gas, wood, process gas (industrial) (ii) Process losses (iii) Solid wate disposal: Incineration, open burning, dumps (iv) Transportation: Motor vehicles (gasoline and diesel powered), off-highway use, aircraft, railroads, vessels, gasoline handling evaporative losses (v) Miscellaneous sources: Forest fires, structural fires, coal refuse burning, agricultural burning	40 CFR 51.1
ASBESTOS	Actinolite, amosite, anthophyllite, chrysotile, crocidolite, tremolite.	40 CFR 61.21
BASELINE CONCENTRATION	That ambient concentration level which exists at the time of the applicable baseline date, minus any contribution from major stationary sources and major modifications on which construction commenced on or after January 6, 1975. The baseline concentration shall include contributions from: (i) The actual emissions of other sources in existence on the applicable baseline date, except that contributions from such existing sources to the extent that a plan revision proposing less restrictive requirements affects such sources was submitted on or before the baseline date and was pending action by the Administrator on that date shall be determined from the allowable emissions under the plan, as revised; and	40 Part 51.24

Term	Definition	Reference
	(ii) The allowable emissions of major stationary sources and major modifications which commenced construction before January 6, 1975, but were not in operation by the applicable baseline date.	
BASELINE DATE	For every part of an Air Quality Control Region (AQCR) designated as unclassifiable or attainment under Section 107(d)(1)(D) or (E) of the Act the date of the first complete application after August 7, 1977 for a permit under this section for any major stationary source or major modification in any part of the AQCR.	40 CFR 51.24
BERYLLIUM	The element beryllium. Where weights or concentrations are specified, such weights or concentrations apply to beryllium only, excluding the weight or concentration of any associated elements.	40 CFR 61.81
BEST AVAILABLE CONTROL TECHNOLOGY (BACT)	An emission limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under the Act which would be emitted from any proposed major stationary source or major modification which the permitting authority, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs determines is achievable for such source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of such pollutant. In no event shall application of the best available control technology result in emissions of any pollutant which would exceed the emissions allowed by any applicable standard under 40 CFR Part 60 and Part 61. If the reviewing agency determines that technological or economic limitations on the application of measurement methodology to a particular class of sources would make the	40 CFR 51.24

Term	Definition	Reference
	imposition of an emission standard infeasible, it may instead prescribe a design, equipment, work practice or operational standard, or combination thereof, to require the application of best available control technology. Such standard shall, to the degree possible, set forth the emission reduction achievable by implementation of such design, equipment, work practice or operation and shall provide for compliance by means which achieve equivalent results.	
CAPITAL EXPENDITURE	An expenditure for a physical or operational change to an existing facility which exceeds the product of the applicable "annual asset guideline repair allowance percentage" specified in the latest edition of Internal Revenue Service Publication 534 and the existing facility's basis, as defined in section 1012 of the Internal Revenue Code.	40 CFR 60.2
COAL	Coal or coal derivatives.	40 CFR 55.02
COMMENCE	As applied to construction of a major stationary source or major modification means that the owner or operator has all necessary preconstruction approvals and either has: (i) Begun, or caused to begin, a continuous program of physical onsite construction of the source to be completed within a reasonable time; or (ii) Entered into binding agreements or contractual obligations, which cannot be cancelled or modified without substantial loss to the owner or operator, to undertake a program of construction of the source to be completed within a reasonable time.	40 CFR 51.24

Term	Definition	Reference
COMPLIANCE SCHEDULE	The date or dates by which a source or category of sources is required to comply with specific emission limitations contained in an implementation plan and with any increments of progress toward such compliance.	40 CFR 51.1
CONDENSATE (OF HYDROCARBONS)	Hydrocarbon liquid separated from natural gas which condenses due to changes in the temperature and/or pressure and remains liquid at standard conditions.	40 CFR 60.11
CONSTRUCTION	Fabrication, erection, or installation of a stationary source.	40 CFR 61.02
CONTROL STRATEGY	A combination of measures designated to achieve the aggregate reduction of emissions necessary for attainment and maintenance of a national standard, including, but not limited to, measures such as: (1) Emission limitations (2) Federal or State emission charges or taxes or other economic incentives or disincentives. (3) Closing or relocation of residential, commercial, or industrial facilities. (4) Changes in schedules or methods of operation of commercial or industrial facilities or transportation systems, including, but not limited to, short-term changes made in accordance with standby plans. (5) Periodic inspection and testing of motor vehicle emission control systems, at such time as the Administrator determines that such programs are feasible and practicable. (6) Emission control measures applicable to in-use motor vehicles, including, but not limited to, measures such as mandatory maintenance, installation of emission control devices, and conversion to gaseous fuels.	40 CFR 51.1

Term	Definition	Reference
CONTROL STRATEGY (cont.)	(7) Measures to reduce motor vehicle traffic, including, but not limited to, measures such as commuter taxes, gasoline rationing; parking restrictions, or staggered working hours. (8) Expansion or promotion of the use of mass transportation facilities through measures such as increases in the frequency, convenience, and passenger-carrying capacity of mass transporation systems or providing for special bus lanes on major streets and highways. (9) Any land use or transportation control measures not specifically delineated herein. (10) Any variation of, or alternative to any measure delineated herein. (11) Control or prohibition of a fuel or fuel additive used in motor vehicles, if such control or prohibition is necessary to achieve a national primary or secondary air quality standard and is approved by the Administrator under Section 211(c)(1)(C) of the Clean Air Act.	40 CFR 51.1
CRANKCASE EMISSIONS	Airborne substances emitted to the atmosphere from any portion of the engine crankcase ventilation or lubrication systems.	40 CFR 85.002
CRITERIA POLLUTANT	Any air pollutant for which national primary and secondary ambient air quality standards have been promulgated, including: sulfur oxides, particulate matter, carbon monoxide, ozone, hydrocarbons, nitrogen dioxide, and lead.	Clean Air Act, Sec. 109 40 CFR 50.5 40 CFR 50.6 40 CFR 50.7 40 CFR 50.8 40 CFR 50.9 40 CFR 50.10 40 CFR 50.11 40 CFR 50.12

Term	Definition	Reference
EMERGENCY RENOVATION	A renovation operation that results from a sudden, unexpected event, and is not a planned renovation. Operations necessitated by nonroutine failures of equipment are included.	40 CFR 61.21
EMISSION	The act of releasing or discharging air pollutants into the ambient air from any source.	40 CFR 51.328
EMISSION FACTOR	An estimate of the rate at which a pollutant is released to the atmosphere as a result of some activity, such as combustion or industrial production, divided by the level of that activity.	AP-42
EMISSION UNIT	Any part of a stationary source which emits or has the potential to emit any pollutant regulated under the Clean Air Act.	40 CFR 51.24
EQUIVALENT METHOD	A method of sampling and analyzing the ambient air for an air pollutant that has been designated as an equivalent method in accordance with this part; it does not include a method for which an equivalent method designation has been cancelled in accordance with § 53.11 or § 53.16 of 40 CFR 53.	40 CFR 53.1
EXHAUST EMISSIONS	Substances emitted to the atmosphere from any opening downstream from the exhaust port of a motor vehicle engine.	40 CFR 85.002

Term	Definition	Reference
EXISTING SOURCE	Any stationary source other than a new source.	Clean Air Act Sec. 111 a(6)
FACILITY	An identifiable piece of process equipment. A stationary source is composed of one or more pollutant-emitting facilities.	40 CFR 51.24
FLOATING ROOF	A storage vessel cover consisting of a double deck, pontoon single deck, internal floating cover or covered floating roof, which rests upon and is supported by the petroleum liquid being contained, and is equipped with a closure seal or seals to close the space between the roof edge and the tank wall.	40 CFR 60.111
FOSSIL FUEL	Natural gas, petroleum, coal, and any form of solid, liquid, or gaseous fuel derived from such material for the purpose of creating useful heat.	40 CFR 60.41a
FRIABLE ASBESTOS MATERIAL	Any material that contains more than 1 percent asbestos by weight and that can be crumbled, pulverized, or reduced to powder, when dry, by hand pressure.	40 CFR 61.21
FUEL-BURNING EQUIPMENT	Any furnace, boiler, apparatus, stack, and all appurtenances thereto, used in the process of burning fuel for the primary purpose of producing heat or power by indirect heat transfer.	40 CFR 51.328
FUEL EVAPORATIVE EMISSIONS	Vaporized fuel emitted into the atmosphere from the fuel system of a motor vehicle.	40 CFR 85.0021
FUGITIVE EMISSIONS	Those emissions which do not pass through a stack, chimney, vent, or other functionally equivalent opening.	40 CFR 51.24

Term	Definition	Reference
GASOLINE	Any fuel sold in any state for use in motor vehicles and motor vehicle engines, and commonly or commercially known or sold as gasoline. (a) "Leaded gasoline" means gasoline which is produced with the use of any lead additive or which contains more than 0.5 grams of lead per gallon or more than .005 grams of phosphorus per gallon. (b) "Unleaded gasoline" means gasoline containing not more than .05 grams of lead per gallon and not more than .005 grams of phosphorus per gallon.	40 CFR 80.2
HAZARDOUS AIR POLLUTANT	An air pollutant to which no ambient air quality standard is applicable and which in the judgment of the administrator causes, or contributes to, air pollution which may reasonably be anticipated to result in an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness.	Clean Air Act Sec. 112 (a)(1)
HAZARDOUS AND TRACE EMISSIONS SYSTEM (HATREMS)	Data base system developed to calculate and store emissions data for lead as well as other possible future criteria pollutants. HATREMS utilizes NEDS data including emission factors, default multiplier units, control efficiency multiplier.	EPA-450/2-78-038
HOT SOAK LOSS	Fuel evaporative emissions during the 1 hour hot soak period which begins immediately after the engine is turned off.	40 CFR 85.002
HYDROCARBON	Any organic compound consisting predominantly of carbon and hydrogen.	40 CFR 60.111
INCREMENTS OF PROGRESS	Steps toward compliance which will be taken by a specific source, including: (1) Date of submittal of the source's final control plan to the appropriate air pollution control agency;	40 CFR 51.1

Terms	Definition	Reference
	(2) Date by which contracts for emission control systems or process modifications will be awarded; or date by which orders will be issued for the purchase of component parts to accomplish emission control or process modification; (3) Date of initiation of on-site construction or installation of emission control equipment or process change; (4) Date by which on-site construction or installation of emission control equipment or process modification is to be completed; and (5) Date by which final compliance is to be achieved.	
INDIRECT SOURCE	Facility, building, structure or installation, real property, road or highway which attracts, or may attract, mobile sources of pollution; i.e., parking lots, parking garages, facilities subject to any measure for management of parking supply, including regulation of existing off-street parking but such term does not include new or existing on-street parking.	Clean Air Act (42 U.S.C. 1857 Seq) Sec. 110
INDIRECT SOURCE	A facility, building, structure, or installation which attracts or may attract mobile source activity that results in emissions of a pollutant for which there is a national standard. Such indirect sources include, but are not limited to: (a) Highways and roads (b) Parking facilities. (c) Retail, commercial and industrial facilities. (d) Recreation, amusement, sports and entertainment facilities. (e) Airports. (f) Office and Government buildings. (g) Apartment and condominium buildings. (h) Education facilities.	40 CFR 52.22

Terms	Definition	Reference
INNOVATIVE CONTROL TECHNOLOGY	Any system of air pollution control that has not been adequately demonstrated in practice, but would have a substantial likelihood of achieving greater continuous emission reduction than any control system in current practice or of achieving at least comparable reductions at lower cost in terms of energy, economics, or nonair quality environmental impacts.	40 CFR 51.24
ISOKINETIC SAMPLING	Sampling in which the linear velocity of the gas entering the sampling nozzle is equal to that of the undisturbed gas stream at the sample point.	40 CFR 60.2
LOWEST ACHIEVABLE EMISSION RATE (LAER)	For any source, that rate of emission based on the following, whichever is more stringent: (i) The most stringent emission limitation which is contained in the implementation plan of the State for such class or category of source, unless the owner or operator of the proposed source demonstrates that such limitations are not achievable; or (ii) The most stringent emission limitation which is achieved in practice by such class or category of source. This term, applied to a modification, means the lowest achievable emission rate for the new or modified facilities within the source. In no event shall the application of this term permit a proposed new or modified facility to emit any pollutant in excess of the amount allowable under applicable new source standards of performance.	40 CFR 51.328
MAJOR MODIFICATION	Any physical change in or change in the method of operation of a major stationary source, or series of contemporaneous physical changes in or changes in the method of operation of a major stationary source, that would result in a significant net increase in that sources potential to emit the pollutant for which the stationary source is major (or that would make the stationary source	

Terms Definition Reference

major taking into account all accumulated net increases in potential emissions occuring at the source, including any initial construction since August 7, 1977). The term "major modification" serves as the definition of "modification" or "modified" when used in the Clean Air Act in reference to a major stationary source.

(ii) A physical change shall not include routine maintenance, repair and replacement.

(iii) A change in the method of operation, unless previously limited by enforceable permit conditions, shall not include:

(a) Use of an alternative fuel or raw material by reason of an order under sections 2(a) and (b) of the Energy Supply and Environmental Coordination Act of 1974 (or any superseding legislation), a prohibition under the Power Plant and Industrial Fuel Use Act of 1978 (or any superseding legislation), or by reason of a natural gas curtailment plan pursuant to the Federal Power Act;

(b) Use of an alternative fuel or raw material, if prior to January 6, 1975, the source was capable of accommodating such fuel or material;

(c) Use of an alternative fuel by reason of an order or rule under section 125 of the Clean Air Act;

(d) Change in ownership of the stationary source; or

(e) Use of refuse derived fuel generated from municipal solid waste.

(iv) Changes are "contemporaneous" only if reductions occur after a notice is filed pursuant to paragraph (v)(4) and before operation of the emission unit or units that will result in emission increases. Also, to be "contemporaneous" all of the emission reductions must be completed and enforceable under the state plan before operation of the emission unit or units that will result in any emission increase. Where the new emission unit is a replacement for an emission unit that is being shut down in order to provide the necessary reductions, the reviewing authority may allow up to 180 days for shakedown or the new emission unit before the existing emission unit is required to cease operation.

Term	Definition	Reference
	(v) For a series of changes in a stationary source to satisfy the requirement of "no net increase," all of the following must be satisfied: (a) All reductions and all increases must be for the same pollutant; (b) The sum of all decreases must be greater than or equal to the sum of all increases; (c) On balance the air quality of the affected area must not be adversely impacted. (vi) In performing the calculation in paragraph (b)(2)(v) of this section to determine whether the sum of all decreases is greater than or equal to the sum of all increases) the following rules shall apply: (a) Subject to the following adjustments, the size of an increase or decrease is determined by the difference between the potential to emit of the change of emissions unit before and after the change. (b) If potential to emit for a changed emission unit was initially higher than allowable emissions, then no offset credit may be taken for decreasing potential to emit down to allowable emissions. (c) The requirement of 40 CFR Part 51, Appendix S, Sections IV. C. 2 and 4 shall apply involving the amount of credit permissible for changing fuels and for replacing one hydrocarbon compound with another of lesser reactivity.	
MAJOR STATIONARY SOURCE	(i) Any of the following stationary sources of air pollutants which emit, or have the potential to emit, 100 tons per year or more of any pollutant regulated under the Clean Air Act (the "Act"): Fossil fuel-fired steam electric plants of more than 250 million British thermal units per hour heat input, coal cleaning plants (with thermal dryers), kraft pulp mills, portland cement plants, primary zinc smelters, iron and steel mill plants, primary aluminum ore reduction plants, primary copper smelters, municipal incinerators capable of charging more than 250 tons of refuse per day, hydrofluoric, sulfuric,	40 CFR 51.24

Terms	Definition	Reference
	and nitric acid plants, petroleum refineries, lime plants, phosphate rock processing plants, coke oven batteries, sulfur recovery plants, carbon black plants (furnace process), primary lead smelters, fuel conversion plants, sintering plants, secondary metal production plants, chemical process plants, fossil-fuel boilers (or combination thereof) totaling more than 250 million British thermal units per hour heat input, petroleum storage and transfer ore processing plants, glass fiber processing plants, and charcoal production plants; (ii) Notwithstanding the stationary source sizes specified in paragraph (b)(1)(i) of this section, any stationary source which emits, or has the potential to emit, 250 tons per year or more of any air pollutant regulated under the Act.	
MALFUNCTION	Any sudden and unavoidable failure of air pollution control equipment or process to operate in a normal or usual manner. Failures that are caused entirely or in part by poor maintenance, careless operation, or any other preventable upset condition or preventable equipment breakdown shall not be considered malfunctions.	40 CFR 60.2
MERCURY	The element mercury, excluding associated elements, and includes mercury in particulates, vapors, aerosols, and compounds.	40 CFR 61.51
MOBILES SOURCES	Including: light-duty gasoline powered vehicles; light-duty diesel powered vehicles; light-duty and heavy-duty gasoline powered trucks; heavy-duty diesel powered vehicles; gaseous fueled vehicles; motorcycles; aircraft; locomotives; inboard and outboard powered vessels; agricultural equipment; heavy-duty construction equipment; snow mobiles; small, general utility engines.	Compilation of Air Pollution Emission Factors (AP-42)

Terms	Definition	Reference
MODEL YEAR	The manufacturer's annual production period (as determined by the Administrator) which includes January 1 or such calendar year: provided, that if the manufacturer has no annual production period, the term "model year" shall mean the calendar year.	40 CFR 85.1021
MODIFICATION	Any physical change in, or change in method of operation of, a stationary source which increases the amount of any air pollutant emitted by such source or which results in the emission of any air pollutant not previously emitted.	Clean Air Act Sec. 111(a)(4)
NATIONAL PRIMARY AMBIENT AIR QUALITY STANDARDS	Ambient air quality standards the attainment and maintenance of which in the judgment of the Administrator (of US EPA), based on such criteria and allowing an adequate margin of safety, are requisite to protect the public health.	Clean Air Act Sec. 109(b)(1)
NATIONAL SECONDARY AMBIENT AIR QUALITY STANDARDS	A level of air quality the attainment and maintenance of which in the judgment of the Administrator, based on such criteria, is is requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of such air pollutant in the ambient air.	Clean Air Act Sec. 109(b)(2)
NECESSARY RECONSTRUCTION APPROVALS OR PERMITS	Those permits or approvals required under Federal air quality control laws and regulations and those air quality control laws and regulations which are part of the applicable State Implementation Plan.	40 CFR 51.24
NEW SOURCE	Any stationary source, the construction or modification of which is commenced after the publication of regulations prescribing a standard or performance applicable to the source.	Clean Air Act Sec. 111(a)(2)
NITROGEN OXIDES	All oxides of nitrogen except nitrous oxide, as measured by test methods set forth in this part.	40 CFR 60.2

Terms	Definition	Reference
NON ATTAINMENT AREA	Any air pollutant an area which is shown by monitored data or which is calculated by air quality modeling to exceed any National Ambient Air Quality Standard for such pollutant.	Clean Air Act Sec. 171(a)(2)(I) (2)
OPACITY	A state which renders material partially or wholly impervious to rays of light and causes obstruction of an observer's view.	Env. Rpt. 125-0132
OPACITY	The fraction of a beam of light, expressed in percent, which fails to penetrate a plume of smoke.	40 CFR 86.077-2
OWNER OR OPERATOR	Any persons who owns, leases, operates, controls, or supervises a facility, building, structure, or installation which directly or indirectly results or may result in emissions of any air pollutant for which a national standard is in effect.	40 CFR 51.1
PARTICULATE MATTER	Any finely divided solid or liquid material, other than uncombined water, as measured by the reference methods specified under each applicable subpart, or an equivalent or alternative method.	40 CFR 60.2
PERSON	An individual, corporation, partnership, association, state, municipality, political subdivision of a state, and any agency, department, or instrumentality of the United States and any officer, agent, or employee thereof.	Clean Air Act Sec. 302 (e)
PETROLEUM	The crude oil removed from the earth and the oils derived from tar sands, shale, and coal.	40 CFR 60.101

Terms	Definition	Reference
PHOTOCHEMICAL OXIDANTS	Products of atmospheric reactions involving organic pollutants, nitrogen oxides (NO_x), oxygen, and sunlight. They consist mostly of ozone, NO_2, and peroxyacylnitrates and other peroxy compounds, and are formed along with other photochemical products, such as aldehydes, nitrous acid, nitric acid, and formic acid. They originate mainly from volatile organic and NO_x emissions produced by human activities. Photochemical oxidant formation is a complex function of emissions and meterological patterns.	Env. Rpt. 31:2151
POINT SOURCE	(1) For particulate matter, sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen dioxide — (i) Any stationary source the actual emissions of which are in excess of 90.7 metric tons (100 tons) per year of the pollutant in a region containing an area whose 1970 "urban place" population, as defined by the U.S. Bureau of the Census, was equal to or greater than 1 million; (ii) Any stationary source the actual emissions of which are in excess of 22.7 metric tons (25 tons) per year of the pollutant in a region containing an area whose 1970 "urban place" population, as defined by the U.S. Bureau of Census was less than 1 million; or (iii) Without regard to amount of emissions, stationary sources such as those listed in Appendix C of 40 CFR Part 51. (2) For lead, any stationary source the actaul emissions of which are in excess of 4.54 metric tons (5 tons) per year of lead or lead compounds measured as elemental lead.	40 CFR 51.1

APPENDIX C LISTING
CHEMICAL PROCESS INDUSTRIES

Adipic acid.
Ammonia.
Ammonium nitrate.
Carbon black.
Charcoal.
Chlorine.
Detergent and soap.

Terms	Definition	Reference
	Explosives (TNT and	
	Hydrofluoric acid.	
	Nitric acid.	
	Paint and varnish manufacturing.	
	Phosphoric acid.	
	Phthalic anhydride.	
	Plastics manufacturing.	
	Printing ink manufacturing.	
	Sodium carbonate.	
	Sulfuric acid.	
	Synthetic fibers.	
	Synthetic rubber.	
	Terephthalic acid.	
	FOOD AND AGRICULTURAL INDUSTRIES	
	Alfalfa dehydrating.	
	Ammonium nitrate.	
	Coffee roasting.	
	Cotton ginning.	
	Feed and grain.	
	Fermentation processes.	
	Fertilizers.	
	Fish meal processing.	
	Meat smoke houses.	
	Starch manufacturing.	
	Sugar cane processing.	
	METALLURGICAL INDUSTRIES	
	Primary metals industries:	
	Aluminum ore reduction.	
	Copper smelters.	
	Ferroalloy production.	
	Iron and steel mills.	
	Lead smelters.	
	Metallurgical coke manufacturing.	
	Zinc.	
	Secondary metals industries:	
	Aluminum operations.	
	Brass and bronze smelting.	
	Ferroalloys.	
	Gray iron foundries.	
	Lead smelting.	
	Magnesium smelting.	
	Steel foundries.	
	Zinc processes.	

Terms	Definition	Reference
	MINERAL PRODUCTS INDUSTRIES Asphalt roofing. Asphaltic concrete batching. Bricks and related clay refractories. Calcium carbide. Castable refractories. Cement. Ceramic and clay processes. Clay and fly ash sintering. Coal cleaning. Concrete batching. Fiberglass manufacturing. Frit manufacturing. Glass manufacturing. Gypsum manufacturing. Lime manufacturing. Mineral wool manufacturing. Paperboard manufacturing. Perite manufacturing. Phosphate rock preparation. Rock, gravel, and sand quarrying and processing. PETROLEUM REFINING AND PETROCHEMICAL OPERATIONS WOOD PROCESSING PETROLEUM STORAGE (Storage tanks and bulk terminals) MISCELLANEOUS Fossil fuel steam electric powerplants. Municipal or equivalent incinerators. Open burning dumps.	
POTENTIAL TO EMIT	The capability at maximum design capacity to emit a pollutant after the application of air pollution control equipment. Annual potential shall be based on the maximum annual rated capacity of the stationary source assuming continuous year round operation. Enforceable permit conditions on the type of materials combusted or processed may be used in determining the annual potential. Secondary emissions do not count in determining annual potential. Fugitive emissions also do not count, except with respect to the following stationary sources and then only to the extent quantifiable:	40 CFR 51.24

Terms	Definitions	Reference
POTENTIAL TO EMIT (cont.)	(i) Coal cleaning plants (ii) Kraft pulp mills (iii) Portland cement plants (iv) Primary zinc smelters (v) Iron and steel mill plants (vi) Primary aluminum ore reduction plants (vii) Primary copper smelters (viii) Municipal incinerators (ix) Hydrofluoric, sulfuric, or nitric acid plants (x) Petroleum refineries (xi) Lime plants (xii) Phosphate rock processing plants (xiii) Coke oven batteries (xiv) Sulfur recovery plants (xv) Carbon black plants (xvi) Primary lead smelters (xvii) Fuel conversion plants (xviii) Sintering plants (xix) Secondary metal production plants (xx) Chemical process plants (xxi) Fossil fuel-fired boilers (xxii) Petroleum storage and transfer units (xxiii) Taconite ore processing plants (xxiv) Glass fiber processing plants (xxv) Charcoal production plants (xxvi) Fossil fuel-fired steam electric plants (xxvii) Any other stationary source category which, at the time of the applicability determination, is being regulated under Section 111 or 112 of the Clean Air Act.	
PRIMARY STANDARD	A national primary ambient air quality standard promulgated pursuant to Section 109 of the Clean Air Act.	(FED) 40 CFR 5.1.
PROPORTIONAL SAMPLING	Sampling at a rate that produces a constant ratio of sampling rate to stack gas flow rate.	40 CFR 60.2

Terms	Definition	Reference
REASONABLY AVAILABLE CONTROL TECHNOLOGY (RACT)	Devices, systems, process modifications, or other apparatus or techniques, the application of which will permit attainment of the emission limitations set forth in Appendix B to 40 CFR 51, provided that Appendix B to 40 CFR 51 is not intended, and shall not be construed, to require or encourage State agencies to adopt such emission limitations without due consideration of (1) the necessity of imposing such emission limitations in order to attain and maintain a national standard, (2) the social and economic impact of such emission limitations, and (3) alternative means of providing for attainment and maintenance of such national standards.	40 CFR 51.1
RECONSTRUCTION	Will be presumed to have taken place where the fixed capital cost of the new components exceeds 50 percent of the fixed capital cost of a comparable entirely new stationary source. However, any decision as to whether reconstruction has occurred will be made in accordance with the provisions of 40 CFR 60.15(1)-(3). A reconstructed stationary source will be treated as a new stationary source for purposes of this section, except that use of an alternative fuel or raw material by reason of an order in effect under Sections 2(a) and (b) of the Energy Supply and Environmental Coordination Act of 1974 (or any superseding legislation), by reason of a natural gas curtailment plan in effect pursuant to the Federal Power Act, or by reason of an order or rule under Section 125 of the Act, shall not be considered reconstruction. In determining best available control technology for a reconstructed stationary source, the provisions of 40 CFR 60.15(f)(4) shall be taken into account in assessing whether a standard of performance under 40 CFR Part 60 is applicable to each stationary source.	40 CFR 51.24

Terms	Definition	Reference
REFERENCE METHOD	A method of sampling and analyzing the ambient air for an air pollutant that is specified as a reference method in an Appendix to Part 50 of 40 CFR 53, or a method that has been designated as a reference method in accordance with this part; it does not include a method for which a reference method designation has been cancelled in accordance with § 53.11 or § 53.16 of 40 CFR 53.	40 CFR 53.1
REGION	(1) An air quality control region designated by the Secretary of Health, Education, and Welfare or the Administrator, (2) any area designated by a State agency as an air quality control region and approved by the Administrator, or (3) any area of a State not designated as an air quality control region under subparagraph (1) or (2) of this paragraph.	40 CFR 51.1
REGIONAL LIMITATION	The requirement that a source which is located in an air quality control region in which a national primary ambient air quality standard for an air pollutant is being exceeded in that region, may not emit such pollutant in amounts which exceed any emission limitation (and may not violate any other requirement) which applies to such source, under the applicable implementation plan for such pollutant.	40 CFR 55
REID VAPOR PRESSURE	The absolute vapor pressure of volatile crude oil and volatile non-viscous petroleum liquids, except liquified petroleum gases, as determined by ASTM-D-323-58 (reapproved 1968).	40 CFR 60.111
ROADWAYS	Surfaces on which motor vehicles travel including, but not limited to, highways, roads, streets, parking areas, and driveways.	40 CFR 61.21

Terms	Definition	Reference
SECONDARY EMISSIONS	Emissions which occur or would occur as a result of the construction or operation of a major stationary source or major modification, but do not necessarily come from the major stationary source or major modification itself. For purposes of this section, secondary emissions must be specific and well defined, must be quantifiable, and must impact the same general area as the secondary source or modification which causes the secondary emissions. Secondary emissions may include but are not limited to: (i) Emissions from ships or trains coming to or from the stationary source or modification; and (ii) Emissions from any offsite support source which would be constructed or would not otherwise increase its emissions.	40 CFR 51.24
SECONDARY STANDARD	A national secondary ambient air quality standard promulgated pursuant to Section 109 of the Clean Air Act.	40 CFR 51.1
SMALL REFINERY	A refinery: (1) Which has a crude oil or bona fide feed stock capacity of 50,000 barrels per day or less, and (2) Which is not owned or controlled by any refiner with a total combined crude oil or bona fide feed stock capacity greater than 137,500 barrels per day. "Owned or controlled" means leased, operated, controlled, supervised, or in ten percent or greater part, owned. Crude oil or bona fide feed stock capacity means that crude oil or bona fide feed stock capacity certified by the Department of Energy, Office of Refining Operations.	40 CFR 80.2

Terms	Definition	Reference
SOLID-DERIVED FUEL	Any solid, liquid, or gaseous fuel derived from solid fuel for the purpose of creating useful heat and includes, but is not limited to, solvent refined coal, liquified coal, and gasified coal.	40 CFR 60.41a
SOURCE	Any structure, building, facility, equipment, installation or operation (or combination thereof) which is located on one or more contiguous or adjacent properties and which is owned or operated by the same person (or by persons under common control).	40 CFR 51.24
SOURCE CLASSIFICATION CODES (SCC)	Code giving specific identification of the source, and defining the units of activity level, and emission factors related to point source activity levels. Emissions may be calculated by multiplying emission factor for each SCC and the activity level.	EPA-450/2-78-026
STACK	Any chimney flue, conduit, or duct arranged to conduct emissions to the ambient air.	40 CFR 51.328
STACK DIAMETER	The inside diameter of a round gas exit at the point of emission; for non-circular exits, it is an equivalent diameter calculated from the cross-section area at the point of discharge. Equivalent Diameter $=\sqrt{1.128}$ Area	APTD-1135
STACK HEIGHT	The vertical distance between the point of emission and ground level.	APTD-1135
STACK EXHAUST FLOW RATE	The total volume of exhaust gas released at the operating temperature of the stack; design or maximum exhast-gas volume.	APTD-1135
STACK TEMPERATURE	The temperature of the exhaust stream at the stack exit reported in degrees Fahrenheit under normal operating conditions.	APTD-1135

Terms	Definition	Reference
STANDARD CONDITIONS	A dry gas temperature of 70° Fahrenheit and a gas pressure of 14.7 pounds per square inch absolute, or 293° Kelvin and a pressure of 101.3 kilopascale (29.92 inches of Hg). Note that other definitions have been specified by EPA.	40 CFR 51.328
STANDARD INDUSTRIAL CLASSIFICATION (SIC)	The classification of establishments by type of activity in which (it is) engaged; for purposes of facilitating the collection, tabulation, presentation, and analysis of data relating to establishments. Classification of establishments by industry on a two-digit, a three-digit, or a four-digit basis.	Standard Industrial Classification Manual
STANDARD OF PERFORMANCE	Requirement of continuous emission reduction, including any requirement relating to the operation or maintenance of a source to assure continuous emission reduction.	Clean Air Act Sec. 302 (1)
STATE IMPLEMENTATION PLAN (SIP)	The plan including the most recent revision thereof, which has been approved or promulgated by the Administrator under Section 110 of the Act (Clean Air Act), and which implements the requirements of Section 110.	40 CFR 65.02
STARTUP	The setting in operation of a stationary source for any purpose.	40 CFR 61.02
STATIONARY SOURCE	Any structure, building, facility or installation which emits or may emit any air pollutant regulated under the Clean Air Act.	40 CFR 51.24
STATIONARY SOURCE FUEL OR EMISSION LIMITATION	Any emission limitation, schedule or timetable of compliance, or other requirement, which is prescribed under the Clean Air Act (other than Section 119, Section 111(b), Section 112 or Section 303 of the Act) or contained in any applicable implementation	40 CFR 55.02

Terms	Definition	Reference
STATIONARY SOURCE FUEL OR EMISSION LIMITATION (cont.)	plan (other than a requirement imposed pursuant to Section 110(a)(2)(F)(v) of the Act), and which limits, or is designed to limit, stationary source emissions resulting from combustion of fuels, including a prohibition on, or specification of, the use of any fuel of any type, grade or pollution characteristic.	
STRUCTURE, BUILDING, FACILITY, INSTALLATION	Any grouping of pollutant-emitting activities which are located on one or more contiguous or adjacent properties and which are owned or operated by the same person (or by persons under common control).	40 CFR 51.24
SUBMERGED FILL PIPE	Any fill pipe the discharge opening of which is entirely submerged when the liquid level is 6 inches (15 cm) above the bottom of the tank; or when applied to a tank which is loaded from the side, means any fill pipe the discharge opening of which is entirely submerged when the liquid level is 18 inches (45 cm) above the bottom of the tank.	40 CFR 51.328
TOTAL REDUCED SULFUR	The sum of the sulfur compounds hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide, that are released during the kraft pulping operation and measured by Reference Method 16.	40 CFR 60.283
TRANSPORTATION CONTROL MEASUR	Any measure, such as reducing vehcile use, changing traffic flow patterns, decreasing emissions from individual motor vehicles, or altering existing modal split patterns that is directed toward reducing emissions of air pollutants from transportation sources.	40 CFR 51.1
TRUE VAPOR PRESSURE	The equilibrium partial pressure exerted by a petroleum liquid as determined in accordance with methods described in American Petroleum Institute Bulletin 2517, Evaporation Loss from Floating Roof Tanks, 1962.	40 CFR 60.111

Terms	Definition	Reference
UNIVERSAL TRANSVERSE MERCATOR (UTM) SYSTEM	System designed by U.S. Army to provide for the projection of square grid zones with convenient measuring units.	APTD-1135
VAPOR RECOVERY SYSTEM	A vapor gathering system capable of collecting all hydrocarbon vapors and gases discharged from the storage vessel and a vapor disposal system capable of processing such hydrocarbon vapors and gases so as to prevent their emission to the atmosphere.	40 CFR 60.111
VARIANCE	The temporary deferral of a final compliance date for an individual source subject to an approved regulation, or a temporary change to an approved regulation as it applies to an individual source.	40 CFR 51.1 (y)
VOLATILE ORGANIC COMPOUNDS (VOC)	Any compound containing carbon and hydrogen or containing carbon and hydrogen in combination with any other element which has a vapor pressure of 1.5 pounds per square inch absolute (77.6 mm.Hg) or greater under actual storage conditions.	40 CFR 51.328
WELFARE	Referring to effects on (welfare) includes, but is not limited to, effects on soil, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being.	Clean Air Act Sec. 302(h)

VARIATION IN DEFINITIONS

A review of state air pollution regulations was performed to determine whether variations to the common terminology listed in Appendix A were present. It was apparent that many of the terms used by state air pollution regulations were indeed the same as the Federal version.

A few terms that were used in state regulations but not listed in Federal texts are presented in Appendix A. In every set of State Regulations or Laws, some section of the text was devoted to the definitions utilized in the particulate document.

One of the more commonly occuring differences between Federal and state definitions is the definition of a source or a facility. State agencies typically refer to a facility as being comprised of one or more sources; the latter referring to an identifiable piece of process equipment capable of emitting one or more pollutants. Conversely, Federal regulations define these two terms in the opposite manner; a source is comprised of one or more facilities. In this case the source represents a plant, and facilities would refer to specific emission points within the plant. Since this and similar discrepancies in definitions has lead to ambiguous enforcement of regulations, the EPA now requires that all SIP's for nonattainment areas adopt Federal definitions in order to be approved.

Terms	Definition	Reference
AIR POLLUTANT	Dust, fumes, mist, smoke, vapor, odor, particulate matter, or any combination thereof, except that such term shall not include uncombined water in the atmosphere unless it presents a safety hazard.	District of Columbia
AIR POLLUTANT	Presence in the outdoor atmosphere of one or more air contaminants in quantities and duration that tend to be injurious to human health or welfare, animal or plant life or property or would reasonably interfere with the enjoyment of life or property.	Alaska, Alabama
AIR POLLUTION SOURCE (PORTABLE)	Any source such as, but not limited to, asphalt batch plants and aggregate crushers which commonly and by usual practice are moved from one site to another. A source will not be considered portable if it remains on one site for more than two years.	Colorado
EXISTING SOURCE	Any source in operation or on which construction has commenced on the date of initial adoption of an applicable rule, or regulation; except that any existing source which has undergone modification of an applicable rule or regulation, shall be reclassified and considered a new source.	Alabama
FACILITY	Machinery, equipment, structures or any part of accessories thereof, installed or acquired for the primary purpose of controlling or disposing of air pollution. It does not include an air conditioner, fan or other similar device for the comfort of personnel.	Utah
FACILITY	A unit or multiple units built, installed or established to serve a particular purpose.	Alaska

Terms	Definition	Reference
MAJOR STATIONARY SOURCE	Any stationary source or modification to a stationary source which increases the allowable emission rate of any air contaminant by an amount equal to or greater than 50 tons per year; 1000 pounds per day; or 100 pounds per hour; whichever is more restrictive.	
POINT SOURCE	Any mobile source, process source or stationary source which is subject to emission rate standards or other standards imposed by these (Conn.) regulations.	Connecticut
PROCESS	Any action, operation or treatment of materials, including handling and storage thereof, which may cause discharge of an air contaminant, or contaminants into the atmosphere, but excluding fuel burning.	District of Columbia
PROCESS	Any stationary emission source other than a fuel combustion emission source or an incinerator.	Illinois
PROCESS OPERATION	Any chemical, industrial, or manufacturing operation including, but not limited to, heat transfer, fluid flow, evaporation, humidification, absorption, extraction, distillation, drying, mixing, classification, sedimentation, decantation, filtration, crystallization, centrifugation, disintegration and material handling.	Delaware
PROCESS SOURCE	The last operation or process which produces an air contaminant resulting from (i) the separation of the air contaminant from the process material, or (ii) the conversion of constituents of the process material into air contaminants and which is not an air pollution abatement operation.	Arizona

Terms	Definition	Reference
PROCESS SOURCE	Any operation, process, or activity except (1) the burning of fuel for indirect heating in which the products of combustion do not come in contact with the process material, (2) the burning of refuse, and (3) the processing of salvageable material by burning.	Connecticut
SOURCE OR FACILITY	Any property, source, facility, building, structure, location, or installation at, from, or by reason of which emissions of air contaminants are or may reasonably be expected to be emitted into the atmosphere.	Georgia
SOURCE OPERATION	Any manufacturing process or any identifiable part thereof emitting an air contaminant into the outdoor atmosphere through one or more stacks or chimney.	New Jersey

REFERENCES

1. The Clean Air Act and Amendments.
2. Code of Federal Regulations (CFR). Title 40. Parts 50, 51, 55, 60 80, 81, 85.
3. The Environmental Reporter. Sections 121, 125, 128.
4. Guide for Compiling a Comprehensive Emission Inventory, Report No. APTD-1135 US EPA, Office of Air and Waste Management, Office of Air Quality Planning and Standards.
5. Compilation of Air Pollutant Emission Factors, AP-42, and Supplements 1-8. US EPA, Office of Air and Waste Management, Office of Air Quality Planning and Standards. April 1973.
6. Federal Register, 44FR J1924, September 5, 1979.
7. Supplementary Guidelines for Lead Implementation Plants, EPA-450/2-78-038. US EPA, Office of Air, Noise, and Radiation, Office of Air Quality Planning and Standards. August 1978.
8. AEROS Manual of Codes, EPA-450/2-76-005 (OAQPS No. 1.2-042) US EPA, Offfice of Air and Waste Management. Office of Air Quality Planning and Standards. April 1976.
9. Interim Guideline on Air Quality Models, OAQPS No. 1.2-080. US EPA, Office of Air Quality Planning and Standards. October 1977.
10. 1974 National Emissions Report: National Emissions Data System of the Aerometric and Emissions Reporting System, EPA-450/2-78-026. US EPA, Office of Air, Noise, and Radiation; OAQPS. April 1978.